

THE
GARDENS' BULLETIN
STRAITS SETTLEMENTS

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Part 3

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THE FERNS OF MOUNT KINABALU.

By Carl Christensen and R. E. Holttum.

INTRODUCTION (R.E.H.).

The present paper contains an account of all ferns known to have been collected on Mount Kinabalu, with the exception of the latest Clemens collections. The occasion for its preparation is the recent collections made on the mountain by the present writer and by the Clemens expedition (still in the field); these include a large number of previously unrecorded species.

At the time of my visit to Kinabalu, Dr. Carl Christensen had for some time past been intending to work out a critical review of all Bornean ferns, and had examined a large number of type specimens; he had also examined almost all previous Kinabalu collections. He was therefore the person best fitted to deal with the new material, and kindly consented to work over my collections, a complete set of which were sent to him. Subsequently I undertook to sort over the Clemens fern collections, which I named in comparison with my own material; the determination of the Clemens collections of the higher numbers (from 26000 upwards) is therefore due to me, with the exception of some critical specimens referred to Dr. Christensen. The publication of an account of the Clemens collection, which adds a number of species to the total, is made possible by the consent of the Keeper of Botany at the British Museum (Natural History), and of Mr. Clemens, to whom I tender my best thanks.

The greater part of the critical and descriptive section of this paper is due to Dr. Christensen. In some cases, with more ample material for examination, and my observations of the plants in the field, I have added critical notes myself, and four new species are described by me. All such cases bear my name or initials. Any field notes contained in the general list are also written by me, but are not initialled.

In this paper are also described a few ferns collected in other parts of British North Borneo (chiefly in the neighbourhood of Sandakan) by Mr. C. Boden Kloss in 1927. Specimens collected by me at Kudat, and also collections from Sarawak and elsewhere by Dr. E. Mjöberg and others, examined by Dr. Christensen, are in some cases also cited as examples of the species concerned and as records of distribution.

The total number of species, from Kinabalu and its foothills, here enumerated is 417, the new collections accounting for about half of this figure. Of these, 30 are described as new species; in addition, *Asplenium Klossii* from Sandakan is described. The new species and new combinations are indicated in distinctive type in the index at the end of this paper.

Earlier Collections and Literature.

Former fern collections on Kinabalu were made by:

1. Sir Hugh Low 1851 and 1858 (Kew).
2. F. W. Burbidge 1877 (Kew).
3. Dr. C. D. Haviland 1892 (British Museum Natural History and partly Kew).
4. Miss Lilian S. Gibbs 1909 (as the former, mostly very scanty specimens).
5. Mrs. Mary S. Clemens and Mr. Le Roy Topping, October—November 1915 (Herbarium of the Bureau of Science, Manila, Herb. Copeland and duplicates in various herbaria).
6. Some few specimens collected by Haslam 1916, Major C. M. Enriquez 1925 and C. Boden Kloss 1928. (Herb. Singapore).

Most of these collections are dealt with in the following papers which are cited in the present paper by the abbreviations indicated in heavy type:

1. **Baker 1879:** J. G. Baker: Report on a collection of ferns made in the North of Borneo by Mr. F. W. Burbidge.—*Journal of Botany* 1879 p. 37.
2. **Baker 1894:** J. G. Baker: Filices in *O. Stapf*: On the flora of Mount Kinabalu.—*Trans. Linn. Soc. Bot. II. 4:* p. 240–254. Contains a list of the ferns collected by Haviland, determined by Baker, and also references to the specimens collected by Low and Burbidge. The whole list, compiled by Stapf, contains 45 species of ferns, being all those known at that time.
3. **Gepp 1914:** A. Gepp: Filices in *Lilian S. Gibbs*: A contribution to the flora and plant-formations of Mount Kinabalu and the highlands of

British North Borneo.—Journ. Linn. Soc. Bot. 42 p. 195–206.

This also gives a complete list of all ferns known from Kinabalu, the number being now 79, which figure, however, includes some species not collected on the mountain itself.

4. **Copeland 1917:** New species and a new genus of Bornean ferns. Chiefly from the Kinabalu collections of Mrs. Clemens and Mr. Topping.—Philippine Journal of Science 12 C: p. 45–65. This paper contains descriptions of 34 new species.
5. **Copeland Keys:** Keys to the ferns of Borneo.—The Sarawak Museum Journal 2: p. 286–424. 1917.

The new species described in the former paper are here listed as *nomina nuda* and reference to the other species found by Mrs. Clemens and Topping are to be found but without citations of numbers; these are quoted in the present paper.

In the present paper, items 3, 4 and 5 above, in which the nomenclature of the *Index Filicum* is used, are quoted only in cases where the name of the species has been changed. The two earlier papers, in which the now nearly forgotten nomenclature of *Synopsis Filicum* is used, are more frequently quoted. Frequent reference is made to the *Index Filicum* (1906), where all necessary synonyms and references to literature may be found for the species there listed; a very great many species have been described subsequently, and for these full references to literature are given, even if they are included in the two Supplements to the Index issued in 1913 and 1917.

Topography.

It is not necessary to quote here all references to previous accounts of the topography of Mount Kinabalu. Moulton gave a summary of all expeditions prior to 1914, with references to literature, in the Sarawak Museum Journal Vol. 2 pp. 138–176 (with map). Of these earlier expeditions that of Miss Gibbs is the most important botanically, and Miss Gibbs's account is the most complete description of the general vegetation of the mountain.

The Clemens and Topping expedition of 1916 added a considerable number of species to the known flora of the mountain, but no topographic account was published. No new ground was broken on this expedition.

Mr. C. Boden Kloss, Director of Museums S.S. and F.M.S., made an ascent in 1928, and published a note on the route, with sketch map and altitudes of stopping places (estimated by boiling-point thermometer). Messrs. F. N.

Chasen and H. M. Pendlebury made a prolonged expedition to the mountain in 1930; Mr. Chasen gave a preliminary note on the collecting places, and the two authors subsequently gave a general account of the expedition. The references to these recent accounts are as follows:

C. Boden Kloss: Bull. Raffles Museum no. 5, pp. 1-2.

F. N. Chasen: Ibid. pp. 3-7.

H. M. Pendlebury and F. N. Chasen: Journ. F.M.S. Museums XVII: pp. 1-38, pl. I-VIII.

During my visit I followed on the whole the same routes as the previous travellers, as I had not much time for exploration. The present path *via* Dallas and Tenompok instead of Kiau and Lobang gives access to botanically rich areas not visited by previous botanical collectors.

I landed at Usukan, and travelled by bridle path, stopping at *Kota Belud*, *Kabayau* (600 ft.) and *Koung* (1300 ft.), to *Dallas*, (3200 ft.), where I remained a few days exploring the valleys in that neighbourhood. I then proceeded to *Tenompok* (4700 ft.), where I left the bridle path and ascended to the summit by the usual route of *Lumu-Lumu* (5500 ft.), *Kamborangah* (7200 ft.) and *Pakka* (10200 ft.). On the downward journey I halted at *Kamborangah* to descend obliquely into the *Kadamaian valley* at a level of about 7000 ft. From *Kamborangah* I descended to *Lobang* (4000 ft.), where the old cave, which sheltered so many travellers, had recently been blocked by a landslide, and thence down the valley to *Menetendok gorge* (3000 ft.), where I halted to ascend the valley of a tributary (the *Kinataki*, a much smaller stream than the one of the same name which has its source in *Marei Parei* ridge). From *Menetendok* I went on to *Kiau* (on the opposite side of the valley from *Dallas*) and thence to the *Marei Parei spur* (camp at 5000 ft.) for a short visit. I then returned to *Dallas*, and finally down the valley again to *Kota Belud* and *Jesselton*. The period actually spent collecting on the mountain was from November 4th to 25th, 1931.

The immediate occasion of my visit was an invitation from Mr. J. Clemens, whose long sojourn on the mountain was then just beginning, to go over to get into touch with his expedition. From Mr. and Mrs. Clemens I received much kind hospitality and help, which I gratefully acknowledge. I wish also to express my thanks to the Resident, East Coast (Mr. Maxwell Hall) and to the District Officer at *Kota Belud* (Mr. G. Robertson) for their generous assistance in connection with my travelling arrangements.

Localities visited by the Clemens expedition and not mentioned above are as follows:

Bungal: between *Koung* and *Kalawat*, altitude about 2500 ft.

Dachang: in the Silau basin at about 10000 ft. altitude.

Kalarwat: on the hills between Koung and Tuaran (end of the road from Jesselton), altitude about 2500 ft.

Kundasan: on bridle path beyond Tenompok, altitude about 3500 ft.

Masilau 1 & 2: localities in the Silau basin.

Menerintog: beyond Marei Parei, altitude about 5000 ft.

Silau basin: the valley system next beyond Tenompok pass.

Field Notes on Kinabalu Ferns.

The open country round Kota Belud, and the secondary forest on the foothills of Kinabalu, contain almost entirely ferns of wide distribution such as are found also in similar situations throughout the Malayan region. In the open country the common *Gleichenia* spp., *Pteridium*, *Blechnum orientale*, *Stenochlaena palustris*, *Lygodium* spp., *Nephrolepis biserrata* and *N. hirsutula*, *Cyathea latebroso*, *Diplazium esculentum* and *Pityrogramma calomelanos* were all frequent. On the steep banks by the bridle paths, even in the most exposed places, *Blechnum orientale* was particularly abundant, and in the moister places formed a very dense growth. On dry rocky banks *Pteris ensiformis* and *Adiantum caudatum* were occasionally seen. On the shady banks near the streams *Tectaria vasta* was the commonest fern; *Tectaria irregularis* occurred in the most shady places. *Dryopteris urophylla* var. *nitida* was very abundant all along the bridle paths, especially in the shelter of thickets; where it grew in more exposed places among grass its leaves were very yellow. *Sphenomeris chinensis* grew on the banks by the path in not too exposed situations all along from the low country up to at least 4000 ft. *Asplenium nidus*, *Platynerium*, *Drynaria* and other epiphytes were occasionally seen, but large trees of sufficient age and suitable bark to carry them were not very abundant.

After passing Kabayau (17 miles from Kota Belud, 600 ft. above sea) the side valleys were much deeper, with steep banks and rocky stream beds, and contained remnants of almost primitive forest. I did not spend much time in this vicinity, but explored one stream for a short distance. On the rocky banks were *Cyclopeltis Presliana* and *Polypodium heterocarpum*; a little higher above the stream were *Cystodium sorbifolium*, *Tectaria malayensis*, *Tectaria trifolia*, and *Dryopteris megaphylla*. Out in the open, in moist grassy places by the path, *Diplazium asperum* was very abundant, and *Tectaria Leuzeana* in more shady spots;

where there was wet open ground by small streams *Dryopteris unita* was frequent, and *Mesochlaena Toppingii* occasional. *Dryopteris contigua* was occasional in drier grassy places. On rocky bank I found *Asplenium squamulatum* and *Cyclophorus varius*.

Beyond Koung the path climbs more steeply. From about 2000 ft. altitude and upwards *Cyathea contaminans* was abundant in the small valleys, often in fine tall groups; *C. latebrosa* also continued frequent. Almost all the country consisted either of clearings for planting rice, or old clearings grown up in various stages of secondary forest. This secondary forest, consisting of a rather small number of tree species, is felled and burnt in patches for rice cultivation. *Pteridium* survives the burning, and to some extent also *Cibotium*; they are the two most abundant ferns on the drier slopes in the secondary forest. The young leaves of *Pteridium* have to be weeded out of the rice fields. I saw one burnt patch which had not been planted with rice; against the black burnt ground the very numerous pale green young *Pteridium* leaves showed up strongly and constituted almost the only vegetation. *Gleichenia* seems to be quite killed by burning. The *Cibotium* is locally very abundant and the largest plants are enormous, the fronds 4 or 5 metres high, the stock short and decumbent. On the steep shaded valley sides, near the streams, at 2000–3000 ft., *Tectaria pleiosora* is very abundant, its leaves rather thick and fleshy in texture, the pinnæ very broad. Unfortunately at the time of my visit hardly any fertile fronds were to be seen. *Diplazium vestitum* v. *borneense*, *Pteris excelsa*, and *Coniogramme macrophylla* are also characteristic of similar situations at about this level.

I visited the bottom of the valley immediately below Dallas, and there found a much richer riverside flora, comparable with that of the main Kadamaian stream above Menetendok, which I will describe later. The stream was almost completely overshadowed by trees up to 50 ft. high, among them a remarkable Meliaceae with pinnate leaves 2 m. long and pendulous inflorescences 3 m. long. On the moist rocks and on trees near the stream were *Asplenium borneense*, *A. spathulinum*, *A. filiceps*, *Antrophyum callifolium*, *Polypodium Emersoni*, *P. insigne*, *P. ithycarpum*, *Loxogramme ensifrons*, *L. involuta* v. *gigas*, and a sterile *Nephrolepis*. Where there was a rather more open valley bottom, and wet black soil, there grew a most remarkable tall *Pteris* which Dr. Christensen has called *P. Holttumii*. This has a very stout wide-creeping rhizome a few centimetres below the soil surface. The rather distant tall erect fronds are not unlike the leafy shoots of some members of

the Zingiberaceæ, and might easily be overlooked. I did not see it at any other place.

The bridle path onwards from Dallas climbs slowly. Above it on the right rises the Dallas-Tenompok ridge, and in this ridge several small rocky valleys in primitive forest have an interesting and characteristic flora at about 3500 ft. Here I found some plants also abundant at Tenompok, but on the whole the floras of the two localities were distinct. Probably the most abundant ferns on wet rocks by the streams were *Polypodium papillosum* and *Asplenium filipes*; these grow only on constantly wet rocks, usually by small waterfalls. In more open places, the stream-bed rocks had plants of *Dryopteris mirabilis*, *D. firmula*, *Campium subsimplex*, *Trichomanes maximum*, *Coniogramme fraxinea*, and *Lomagramma Brooksii*. The last-named species, like all of its genus which I have seen, starts life creeping over the stream-bed rocks, the rhizome at this stage quite slender, the fronds suberect and the pinnae rather small; such creeping rhizomes wander on until they meet a tree, up which they may climb. The climbing rhizome rapidly develops to a much larger size, and bears fronds of full mature size growing out horizontally from the tree. Only such climbing plants bear fertile fronds, and the mature form of the fern is never seen in the creeping stages. Fertile fronds of *Lomagramma*, like those of most species of *Teratophyllum*, are rarely found, and are perhaps dependent on an exceptionally dry season, or exposure due to the fall of a neighbouring tree. On the ground in the forest one of the commonest ferns was *Diplazium cordifolium*, the typical form and also var. *pariens*. Others were *Heterogonium profereoides*, *Dryopteris aciculata*, *Lindsaya tenera*, *Microlepsia Hookerae*, *Diplazium fraxinifolium* var. *grossum* and *Dryopteris crassifolia*. *Lindsaya repens* Bedd. was rather frequent on the lower parts of tree trunks in moist situations, its finely dissected bathyphylls sometimes very conspicuous.

Somewhat further on, on the forest edge, were three remarkable ferns which I did not find elsewhere. On the grassy bank of the path were *Dryopteris multiseta* and *Dennstaedtia rufidula*, the one very scaly, and the other even more densely hairy; and actually in the thicket of the forest edge was *Dennstaedtia cuneata*. The last-named grew to an enormous size, the erect fronds 4 m. high, a fresh pale green, rising from a very thick creeping rhizome. Also in the edge of the forest were enormous plants of *Tectaria Leuzeana*.

At Tenompok, 4700 ft., I explored the forest fairly thoroughly for terrestrial ferns and low epiphytes, but probably missed some of the epiphytes from the upper tree

branches. The low-level epiphytes (i.e., those near the ground level in the forest) were : *Leucostegia hymenophylloides*, *Asplenium scolopendrioides*, *A. acutiusculum*, *Polypodium Reinwardtii*, *Trichomanes bipunctatum*, *Hymenophyllum eximium*, *H. thuidium*, and *Monogramma trichodea*. The high level epiphytes were: *Polypodium albidosquamatum*, *P. rajaense*, *P. pallens*, *P. incurvatum*, *Loxogramme ensifrons*, *L. nidiformis*, *Cyclophorus borneensis*, *Hymenodermis revoluta*, *Humata kinabaluensis*, *Asplenium pachychlamys*, *Elaphoglossum petiolatum*, *E. callifolium*, *Davallia embolostegia*, and *Vittaria zosterifolia*. A single felled tree had on it nine species of epiphytic ferns, besides orchids and *Aeschynanthus* sp.

The terrestrial fern flora at Tenompok may be divided into the following sections: ferns of the open (beside the bridle path), and ferns of the forest, the latter being again divided into streamside ferns and others. These divisions are not quite sharp, as some ferns tend to grow just in the edge of the forest. The streams at Tenompok were all small, steep and rocky, completely shaded by forest, and the fern flora of the larger open streams, as seen at Lobang, did not appear, except that some species which would normally grow on the banks of larger streams found suitable positions on the earth banks of the bridle paths.

Ferns of open places were first the *Gleichenias*, *G. linearis* in one or more varieties, and *G. Norrisii*. *G. Norrisii*, here as in the Peninsula, is a fern of the edges and clearings in rather high forest, not of exposed ridge-tops; in the Peninsula it occurs at mid-elevations in the hills, at about 2000 ft., and presumably it is not actual altitude or temperature so much as the rather humid and half-shaded situation that is the determining factor in its case. It is evidently a fern of rather narrow limits of toleration, perhaps on the part of the gametophyte. Other ferns of open places were *Hypolepis Brooksiae* and *Histiopteris stipulacea*. On the bank just in the shade of the forest edge were *Dryopteris cuspidata*, *Diplazium poiense*, *Asplenium porphyrorachis* and *Polystichum gemmiparum*; in rather wet places especially *Microlepia manillensis* was abundant.

Ferns of the forest shade were the remarkable *Angiopteris ferox* (rather small for the genus, abundant), *Dryopteris baramensis* (abundant), *Diplazium barbatum* (abundant), *Dryopteris sparsa*, *D. gracilescens*, *D. heterocarpa*, *D. Toppingii*, *D. multisora*, *Dennstaedtia ampla*, *Cyathea latebrosa*, *C. recommitata*, *C. tripinnata* (on forest edge), *Pteris purpureorachis*, *Lindsaya crispa*, and *Asplenium normale*. By the streams in the forest were: *Asplenium filipes*, *Dryopteris tenompokensis* (on rocks, with

erect fertile fronds), *D. hirtipes* (abundant), *Marattia pellucida*, *Trichomanes apiifolium*, *T. cupressioides*, *Lindsaya malayensis*, and *Tectaria crenata*. By the streams were also abundant as low-level epiphytes *Asplenium scolopendrioides* and *Leucostegia hymenophylloides*, the latter with much larger leaves than when growing in more exposed places.

The ridge of the mountain climbs little between Tenompok and Lumu Lumu, with ups and downs; on the higher steeper parts the forest is dwarfed and open, but less so than beyond Lumu Lumu. On the steeper parts *Plagiogyria adnata* was the characteristic terrestrial fern; for a note on this species and its relation to *P. Clemensiae* see the systematic section. Species of *Plagiogyria* seem always to be ferns of dwarf forest on high mountain ridges. Of terrestrial ferns of higher forest on less steep ground I collected the following: *Diplazium atosquamosum* (abundant just above Tenompok), *Dryopteris multisora* (occasional all along), *D. baramensis*, *D. crassifolia*, *Diplazium speciosum*, *Microlepia Hookeriana*, and *Polystichum carvifolium* (?). On the higher ridges grew *Blechnum vestitum* and a variety of *Gleichenia linearis* with short broad branches, glaucous beneath.

Where the forest was fairly tall, all the smaller vegetation was hung with trailing mosses and liverworts, and all tree trunks were covered with moss. On the ridge-tops, where the forest was much lower, the trees were more thickly covered with moss-cushions, but less of the pendulous mosses; on the ground also were cushions of mosses and liverworts. The trees were laden with epiphytic orchids, and a smaller quantity of ferns. Of the ferns, the climbing species *Lindsaya repens* and *L. pectinata* were the most abundant. Probably next in abundance was *Polypodium consociatum*, growing among the mosses. Other epiphytes were: *Polypodium Curtisii* (abundant near Tenompok), *P. lancifolium*, *P. albidosquamatum*, *P. rajaense*, *Vittaria angustifolia*, *Hymenophyllum eximium*, *H. Neesii*, *H. pachydermicum*, *Trichomanes proliferum* and *T. pallidum*.

Small *Cyathea* plants were frequent, but I did not see any mature tree ferns except a magnificent *Dicksonia Blumei*, with very stout trunk and long red-brown hairs all over stipe and rachis. At Lumu Lumu, in wet ground by a small stream, were plants of *Cyathea capitata*, the largest with a stem 30 cm. high; it is one of the largest simply pinnate species.

Beyond Lumu Lumu the spur of the mountain ascends more steeply, but always there are alternations of narrow exposed ridges with small trees, and broadly rounded parts

of the spur carrying rather high forest. In the latter, a locally abundant terrestrial fern was *Polystichum carvifolium* (?); *Dryopteris crassifolia* also occurred. Terrestrial ferns were abundant in the more open forest on the steep ridges. These included several species of *Gleichenia*: *G. linearis*, *G. longissima*, *G. bullata*, *G. hirta* (very scaly), and *G. microphylla* var. *semivestita*. In exposed places at above 8000 ft. occurred also *G. borneensis*. *G. bullata* extended up the mountain to the limit of tree growth, much dwarfed at the highest altitudes. Other terrestrial ferns were *Lindsaya diplosora*, *Dryopteris viscosa* and *D. supravillosa*, *Plagiogyria*, *Blechnum vestitum*, and on steep banks locally *Cheiropleuria bicuspis*, mostly very small with stiffly coriaceous leaves and long creeping rhizomes.

Two tree ferns were fairly abundant at the 6000–7000 ft. level, *Cyathea ramispina* and *C. kemberangana*, the former particularly conspicuous with its much-branched “aphlebiæ” at the bases of the stipes. These aphlebiæ are at first green, but turn brown before the leaf has ceased to function; they persist on the old leaf-bases and form a complete covering for the trunk of the fern. The youngest plants lack the aphlebiæ, but could readily be recognised by their black stipes. The limited but dense covering of pale scales at the base of the stipes of *C. kemberangana* was also characteristic. *Dryopteris subarborea* also occurred, its leaves equalling in size those of small *Cyatheas*.

Of epiphytes the following were collected. *Polypodium consociatum* occurred abundantly almost up to Kamborangah, and locally *P. clavifer*; other small species were *P. bryophyllum*, *P. mollicomum*, *P. streptophyllum*, *Scleroglossum* spp., *Hymenophyllum pilosissimum*, *H. microchilum*, *Trichomanes palmatifidum* and *T. album*. Larger epiphytes, on the higher or more exposed tree-branches were: *Polypodium albidopaleatum*, *P. stenopteris*, *Elaphoglossum Beccarianum* and *E. decurrens*.

From Kamborangah (7200 ft.) I made a descent obliquely into the Kadamaian valley, reaching the stream at a level slightly below that of the camp. As one leaves the crest of the ridge, the dwarfed forest gives place to higher trees, with an undergrowth of fine bamboo. In this lower parts of trees and fallen logs are covered with masses of liverworts, and sometimes on large trees are great cushions of liverworts at intervals on the trunks. Lower down were a fair quantity of Dicranaceous moss cushions on the ground and on fallen logs, but always mostly liverworts. The forest was not very densely shady, and had a rather open undergrowth of bamboo, rattans, and some ferns. The common fern was *Polystichum carvifolium* (?), and also abundant were *Dryopteris viscosa*,

D. multisora, *Plagiogyria Clemensiae*, *Acrophorus Blumei*. Less frequent were *Blechnum vestitum* (never abundant nor large except near the ridge top), *Plagiogyria glauca* (sterile), and *Diplazium cordifolium*.

Near small streams the fern flora was richer. *Pteris flava* was quite abundant and often large, but not often fertile. Other ferns abundant in this situation were *Diplazium tricholepis*, *Athyrium macrocarpum*, *Trichomanes maximum*; also occasionally *Blechnum Patersoni*, *B. Finlaysonianum* and *Cyathea capitata*. Of large tree ferns *Cyathea Korthalsii* and *Dicksonia Blumei* were noted; on the former were some very large plants of *Spiridens Reinwardtii* growing epiphytically half way up the trunk. *Blechnum Finlaysonianum* is a low country fern in the Malay Peninsula, and I was surprised to find it at so high an altitude.

On approaching the main stream the forest became much richer in ferns and all the trees were loaded with pendulous bryophytes. Of terrestrial ferns I found the following: *Dryopteris baramensis*, *D. megaphylla*, *D. stegogramme*, *Polystichum obtusum* (sometimes as an epiphyte), *Athyrium amoenum*. On the forest edge, by the river, was a fern thicket containing *Hypolepis tenuifolia*, *Dryopteris subarborea*, *D. megaphylla*, and other large species. On the rocks by the stream were a pretty pink balsam (*Impatiens Havilandii*), *Blechnum Patersonii*, and *Polypodium dolichosorum* (with erect fronds). In the forest beyond the stream were some very large plants of *Angiopteris*. Epiphytic ferns on trees near the river were *Polypodium calcipunctatum* (very large), *P. celebicum*, *P. venulosum*, and *Asplenium tenerum*.

At Kamborangah the forest is dwarfed, with much undergrowth of *Gleichenia* and *Nepenthes* (*N. Lowii*). Above it the ridge broadens out, and for some distance carries a much taller mixed forest, with bamboo undergrowth, like that encountered on the way to the valley below Kamborangah. Higher up, the ridge-top becomes narrower again, and the small trees carry many small epiphytic ferns, including a number of *Grammitis* spp. (*Polypodium Hieronymusii*, *P. fasciatum*, *P. Havilandii*, *P. calcipunctatum* and *P. kinabaluense*) and also *Hymenophyllaceæ*. Throughout this forest, in the wetter places, occur *Plagiogyria Clemensiae*, *Dryopteris viscosa*, and occasionally *Athyrium Moultonii*.

In a few places there are clearings (one, on a prominent ridge-end, seemed fairly clearly to have been burnt) carrying only low vegetation. In these places small ferns were very abundant, a very dwarf *Dipteris* forming locally

a pure growth, or mixed with *Gleichenia borneensis*. In wetter places *Paesia radula* also occurred.

There is a more or less gradual transition to a more open type of ridge forest, consisting almost entirely of *Leptospermum* spp. and conifers (*Dacrydium* predominating) at first chiefly with an undergrowth of *Gahnia* and plants of similar habit, with few bryophytes or ferns, either terrestrial or epiphytic. In clearings, trailing *Lycopodium* spp. are very abundant, also *Gleichenia* spp. and *Dipteris*. Somewhat above 9000 ft. *Cyathea Havilandii* and *Nepenthes villosa* become very abundant in this *Dacrydium*-*Leptospermum* forest, forming the bulk of the undergrowth, the *Cyathea* with almost erect fronds and no trunk showing above ground level. The *Nepenthes* trails along the ground, and rarely climbs. *Schizaea fistulosa* also occurs here. Mosses of the genus *Macromitrium* were occasional epiphytes, but many of the trees bore none.

On reaching about 10000 ft. the track leaves the crest of the ridge and descends a little into the valley to the stream at Pakka. The valley forest is notably wetter than that of the ridge top, and becomes at once mossy; by the stream itself all trees were loaded with bryophytes, chiefly (as at almost all places) liverworts. The ground vegetation of this valley forest consists largely of a tall-leaved orchid, *Eria grandis*. There were also some fine ferns, including the large species *Polystichum Holttumii* and *Dryopteris paleacea*, the very finely dissected *Athyrium pulcherrimum* and *Acrophorus Blumei*, and as usual *Plagiogyria Clemensiae* and *Dryopteris viscosa*.

Of epiphytes I found *Hymenophyllum australe*, *Asplenium Elmeri*, *Loxogramme parallela*, *Polypodium monocarpum*, *P. pakkaense*, *P. sumatranum*, *P. cucullatum* v. *subgracillimum* and *Elaphoglossum angulatum*.

The stream is very steep and rocky. In an open place, among a mass of liverworts which covered the rocks beside the stream, *Hymenophyllum paniculiflorum* grew abundantly. On a shaded vertical rock was a large quantity of *Trichomanes Teysmannii* and *Hymenophyllum serrulatum*. On a few of the rocks, above flood level, were small *Grammitis* plants, and *Athyrium macrocarpum*.

A short climb above Pakka brings one to the edge of the continuous forest. After that is scrub or small patches of forest at intervals, separated by bare sloping rocks, the patches of vegetation becoming smaller and the bare rocks more extensive until finally there is nothing but rock. In this bare sloping rock are many crevices in which plants grow; the crevices are the drainage channels. Occasionally there is a hollow containing a pool of water. The *Leptospermum* which is the most abundant tree in much of the

forest about Pakka grows in these crevices, at the higher altitudes dwarfed to only a few inches high. With it are a few other woody plants, and a number of herbs and grasses, as described by Miss Gibbs. The small ferns of the summit region do not usually grow in these exposed crevices, which is doubtless why Miss Gibbs overlooked them. They occur only where an overhanging rock affords shelter from insolation, and usually near a trickle of water. The most abundant is *Polypodium kinabaluense*, and near the summit I found *Oreogrammitis Clemensiae*. Other ferns found in similar situations were: *Asplenium malayopalpinum*, *Athyrium Clemensiae*, *Polystichum kinabaluense*, *Polypodium caespitosum*. In the undergrowth of one of the last thickets were *Dryopteris adnata* and *Hymenolepis squamata* var. *borneensis*, the latter with erect fronds. Two interesting ferns of the summit region, not found by me, are *Stenolepia tristis* and *Blechnum fluviatile*.

On the descent of the mountain, I followed the same path as far as Kamborangah, descending thence to Lobang, the route taken by Miss Gibbs for both ascent and descent. The drop of about 3000 feet, down the side of the main spur of the mountain, is a very steep one, and in many places the ground is so steep and rocky as to carry no large trees. Not far below Kamborangah *Monachosorum subdigitatum*, a fern not previously seen, was found in small quantity, terrestrial in a rocky place. Of epiphytes, I found the very large *Humata kinabaluensis* var. *subvestita*, *Polypodium subauriculatum*, and *P. subminutum*. In the lower part of the descent, on rocky ground, *Asplenium lobangense* was the commonest fern; in the more open places *Tectaria Leuzeana* and *Dryopteris megaphylla* also occurred.

At the bottom of the descent two streams were crossed. On the rocks by the streams, just above flood level, the graceful little *Adiantum diaphanum* was very abundant. Also on the rocks *Dryopteris hirtipes* was frequent, as at Tenompok. Terrestrial in the neighbouring forest were *Pteris Grevilleana*, the very large *Angiopteris Holttumii*, and *Lomagramma Brooksii* (on rocks and trees).

I ascended one of small streams for a little distance, and then descended to the main Kadamaian river in the valley bottom, following it as far as the Menetendok gorge. The small stream was very steep and rocky. On its rocks were some of the same ferns found at Tenompok, and also *Diplazium pallidum* and *Athyrium silvaticum*. Beside the stream was a very tall *Cyathea contaminans*, unusually slender and the stipes hardly muricate; the rather shady and very moist conditions were perhaps the cause of its peculiar character. In the forest near the stream, and again

lower down by the main river, were a few plants of *Botrychium daucifolium*.

The descent from Lobang camp to the Kadamaian river was through fairly high forest. The ground was still fairly steep and rocky, and we passed another small stream. There were a considerable number of terrestrial ferns and a rather rich ground vegetation generally. Among the ferns were *Microlepia strigosa*, *Tectaria vasta* (abundant throughout), *Polystichum gemmiparum* and *P. aristatum*, *Diplazium tabacinum*, *D. fraxinifolium*, *D. sp.* near *Woodii* (no. 25579), and *Dryopteris sparsa*. Near the stream *Lomagramma Brooksii* was very abundant creeping over the rocks and climbing some of the trees, but no fertile fronds were seen. *Hymenophyllum pachydermicum* was abundant on some tree trunks.

The trees and rocks beside the river bore a large number of ferns. A contrary statement is made by Miss Gibbs, who perhaps crossed the river below the limit of high forest, missing the most interesting part of its course. On one tree were the following species: *Asplenium tenerum*, *A. spathulinum*, *A. filiceps*, *Davallodes Burbidgei*, *Polypodium ithycarpum*, *P. sarawakense*, *Cyclophorus borneensis*, and several orchids. *Davallodes Burbidgei* was frequent on the trees, while *D. borneensis* was more abundant on rocks and rarely grew epiphytically. Other ferns growing on rocks were: *Polypodium commutatum*, *Tectaria Holttumii*, *Dryopteris dissecta*, *D. subpubescens*, and *Polypodium heracleum*. On small rocks by the river's edge, where it would be frequently subject to flooding, grew *Diplazium grammitoides*, in stature, habit and habitat agreeing closely with *Dryopteris calcarata v. ciliata* in the Malay Peninsula.

Passing through the short Menetendok gorge, with almost sheer walls of rock estimated at 300 feet high, we again reached cultivated ground. High up, the rocks were covered with pendulous fronds of *Nephrolepis barbata*. In the secondary growth round about was much *Laportea*, which made exploration difficult. The Kinataki, a small tributary of the Kadamaian, joins the main stream just below the gorge, and in its lower part were few ferns of interest. Further upstream, in higher forest, conditions were more favourable for ferns, and the epiphytic species common by the main stream were found. The stream being narrower than the Kadamaian, conditions were more sheltered. The *Diplazium grammitoides* was absent, but *Adiantum diaphanum* common all along on the rocks, and locally *Diplaziopsis javanica* and *Campium quoyanum*. The smaller trees were covered with pendulous liverworts. On the sloping ground above the stream, in the forest, *Heterogonium profereoides* and *Tectaria pleiosora* were frequent,

the latter always sterile; also present were *Tectaria vasta*, *T. Leuzeana* and *Dryopteris microthecia*. Angiopteris plants of large size were occasional; I did not attempt to collect them all, but took specimens of *A. angustifolia*. *Tectaria coadunata* was once seen, pendulous, on a vertical mossy rock over the stream. At the furthest point reached, in a wet shady place in high forest near the stream grew *Didymochlaena truncatula* and *Coniogramme macrophylla*.

Returning by a path at a higher level, leading partly through well-grown secondary forest, I found *Dryopteris urophylla* v. *nitida* as a very abundant terrestrial fern, locally forming a continuous undergrowth.

The open country between Menetendok and Kiau yielded few ferns. Beside the rice fields *Pteris biaurita* was common, also *Pityrogramma calomelanos* (not seen higher up on the mountain) and the usual ferns such as *Nephrolepis biserrata* which are characteristic of open places. The only epiphytes noted were *Polypodium subauriculatum* and *Cyclophorus borneensis*.

From Kiau I went to the Marei Parei spur. The path leads round the shoulder of the Gurulau spur, on the slopes of which Kiau stands, through secondary growth and clearings, and down to the Kenokok river. From there to the Dahombang river is a fairly good forest growth, on fairly level ground, with herbaceous undergrowth containing many of the ferns seen near Dallas and Tenompok. The Heterogonium was frequently seen, and Lomagramma in rocky places. Where the path descended a little to the Dahombang river, the fern flora became more luxuriant. *Asplenium borneense* was very frequent and large, climbing on the rocks. On small trees near the river a pendulous Selaginella was epiphytic, with many bryophytes. The stream bed itself was quite bare of all plant life, owing to a large landslide in the headwaters of the stream not long previously; the earth and stones, borne down by the flood, had scoured the boulders of the river bed perfectly clean, and it bore a very different appearance from that of the Kadamaian.

From the Dahombang the path climbs first up the slopes of the Penibukan ridge, where *Pteris rangiferina* and *Cyathea longpipes* were the most interesting ferns, both occurring on the crest of the ridge. The path descends a little to cross the Kinataki (not the stream of the same name which flows into the Kadamaian), and then climbs the Marei Parei spur. The ridge forest continues for a time much as on the Penibukan ridge, but gradually the trees become shorter and more mossy, and conifers more numerous. In the clearing on the ridge where we camped were some interesting ferns. In wet ground, in fully

exposed places, grew *Dryopteris lithophylla*, its young fronds covered with mucilage, and in moist rock crevices, also fully exposed, was *Schizoloma Jamesonoides*, with bright red young leaves. In the edge of the neighbouring thickets was *Matonia Foxworthyi*, which I did not find on the main spur of the mountain.

Above the camp site at Marei Parei (5000 ft.) the ridge rises steeply for some little distance, the ground being rocky and covered with low flat-topped trees of *Leptospermum* and bushes of other species, or open and covered with *Cyperaceæ*; in the wetter places were some plants of *Nepenthes rajah*. At the top of this steep rise a low mossy forest begins, consisting of close-growing slender trees thinly draped with liverworts. The ground vegetation was poor, containing a slender rattan and also some of the ferns found lower down the ridge, with *Diplazium Hewittii* in addition. No *Plagiogyria* nor *Dryopteris viscosa*, characteristic plants of the main spur at about this altitude, were seen. *Nepenthes villosa*, long climbing plants, was abundant. The tree growth consisted of many species, including several species of *Podocarpus* and *Dacrydium*. Epiphytes were few, the only fern noted being *Scleroglossum debile*.

Rather suddenly the ridge broadens out, as it does above Kamborangah, and carries a forest of quite tall trees, with bamboo undergrowth. The ground was rocky, and conditions evidently very humid, though no stream appeared to be near. The trees were loaded with pendulous bryophytes. *Trichomanes maximum* and *Monachosorum subdigitatum* were abundant as terrestrial ferns, others being *Diplazium speciosum*, *D. cordifolium*, *Pteris kinaluensis*, *Dryopteris multisora* and *D. stipellata*. A little further up, *Dryopteris viscosa* became abundant, often with quite tall stems like miniature tree ferns, and also *Polystichum carvifolium* as near Kamborangah, the *Trichomanes* and *Monachosorum* gradually disappearing. There were also a few plants of *Acrophorus Blumei* and *Blechnum Patersoni*. The ground became steeper and the forest smaller, and I found a few sterile plants of *Blechnum Fraseri* with erect slender stems up to a metre high. Several epiphytic ferns characteristic of Tenompok and Lumu Lumu were seen, and also *Asplenium nigrescens*.

The steep ridge higher up bore small very mossy forest much as that near Kamborangah under similar conditions (the "moss" always consisting chiefly of liverworts), *Dryopteris viscosa* being always the common ground fern, with *Plagiogyria*, *Athryium macrocarpum* (small), and in rocky places *Cheiropleuria*, large and typical, not small and coriaceous as near Kamborangah. *Gleichenia* spp. occurred all along, and small plants of *Cyathea ramispina*.

PHYTOGEOGRAPHICAL NOTE (C. CHR.).

The number of species known only from Kinabalu is rather large, but this does not mean that all of them are endemic there; on the contrary, I think it probable that many of them occur also on the mountains in other parts of Borneo, especially in the mountainous region on the boundary between Sarawak and Dutch Borneo. Dr. E. Mjöberg's collections from Mt. Tibang and Mt. Murud contain several species known previously from Kinabalu only. Considering further that several species among the additions to the Kinabalu flora recorded in this paper have previously been known only in Sarawak, I conclude that the number of species really endemic is not very large.

The fern flora of Kinabalu (and of Borneo as a whole) is intimately related to that of the Malay Peninsula and Sumatra, and in a somewhat lesser degree to that of the Philippines, especially the island of Mindanao. It is not so nearly related to that of Java, and still more remote from that of New Guinea, though the two big islands have a number of species in common.

Among the most interesting records of increased distribution contained in this paper are the following: *Blechnum fluviatile*, known previously from Australia and New Zealand; *Stenolepia tristis*, known previously only from the mountains of Java; *Paesia radula*, previously only known from Sumatra, now reported from Kinabalu and also from Celebes; *Heterogonium profereoides*, previously known only from Mindanao.

Of the above, *Blechnum fluviatile* is a notable addition to the list of species which form a south-temperate element in the Malayan fern-flora, others on Kinabalu being *Schizaea fistulosa*, the two species of *Eugleichenia*, *Pteridium esculentum*, and the remaining species of *Blechnum*, section *Lomaria*.

ENUMERATION OF THE SPECIES.

Our ideas of the natural relationship of the tribes and genera of ferns have considerably changed since the year 1900, when Prof. Diels published his scheme of classification (*Die Natürl. Pflanzenfamilien* 1, 4), which I followed in my *Index Filicum*, but we still lack a general treatise in which a new and more natural system is worked out. The only work of this kind in recent years is Dr. E. B. Copeland's interesting paper: The Oriental Genera of Polypodiaceæ¹, in which he gives many valuable contributions to the right conception of a natural, phylogenetic classification of ferns, but unfortunately he deals with the Asiatic genera only. I agree with him on the whole in regard to his ideas of the mutual relationships of these genera, less so in his delimitation of the individual genera. In this paper I have consequently arranged the genera in a manner which corresponds in many respects with Copeland's ideas, but have maintained most genera as defined in my *Index*, chiefly because I do not desire here to create a considerable number of new combinations. (C. Chr.).

OPHIOGLOSSACEÆ.

OPHIOGLOSSUM LINNÆUS.

- O. pedunculosum** Desv.—Kiau (Cl. 10093, Tp. 1636), near Dallas (H. 25269, Cl. 27415, 26158), Silau basin, 7000 ft. (Cl. 29280).

On bare ground in open places; often brought in by the Dusuns, but not often seen by me.

- O. reticulatum** L.—t. Copeland, *Keys* 299, not seen.

- O. intermedium** Hook.—Kiau (Cl. 10243).

- O. pendulum** L.—Tenompok (Cl., s.n.).

- O. Moultoni** Copel Journ. Straits Br. R. Asiatic Soc. no. 63, 72 (1912).—Tenompok (Cl. 24768, 28320).

The largest fronds of these collections agree with the description of the species; others are shorter and narrower, but of the same general shape. Some however seem to grade into more typical *O. pendulum*, and I think that more field study is needed before the status of the species can be decided. (R.E.H.).

BOTRYCHIUM SWARTZ.

- B. daucifolium** Wall.—Gurulau Spur (Tp. 1840), near Menetendok (H. 25578), Tenompok (Cl. 29210, 27982), Below Dachang (Cl. 29049).

In rich soil in shady valley forest, near streams.

(1) University of California Publications in Botany, 16, no. 1. 1929.

HELMINTHOSTACHYS KAULFUSS.

- H. zeylanica** (L.) Hk.—Low damp woods, 1000 ft. (Cl. 27666).

MARATTIACEÆ.

ANGIOPTERIS HOFFMANN.

- A. angustifolia** Presl.—Menetendok (H. 25716). New to Borneo.
- A. ferox** Copeland, Phil. Journ. Sci. 6C: 134. 1911.—Dahombang (Haviland 1476), Tenompok, abundant in forest (H. 25382).

A peculiar species, known previously from Mt. Penrissen, Sarawak; the black-brown stipes and rachises are densely bearded with blackish, linear scales.

- A. Holttumii** C. Chr. n. sp.—Maxima, 4 m. alta, pinnis fere 1 m. longis pinnulis ca. 35-jugis, subcontiguis, subsessilibus (petiolis vix 8 mm. longis, alatis), linearibus vel oblanceolatis, 15 cm. longis, 2.5 cm. latis, basi subequaliter truncatis, in apicem brevem acuminiatum grosse serratum sat subito angustatis, marginibus irregulariter et leviter dentatis. Venulis recurrentibus distinctis, ultra medium vel fere ad costam productis. Soris 1.5–2 mm. a margine remotis, sporangiis 5–7-jugis. Textura herbacea, colore superne obscuro inferne pallidiore, costis costulisque subtus paleis parvis persparse onustis.

KINABALU: Lobang (H. 25552, type in Herb. C. Chr.), Kiau (Clemens 10234).

A mighty fern, nearest *A. arthrocarpa* v.A.v.R. Bull. Jard. Bot. Buit. III Ser. 5: 183, but pinnules sessile; the Bornean *A. muricata* Pr. is nearly as large, but the recurrent vein indistinct or none.

- A. Brooksii** Copel. Phil. Journ. Sci. 10C: 145, t.1. 1915.—Dallas-Tenompok ridge, in ravine (Cl. 26825, 27354). Known previously from Sarawak. In general appearance this is very like *A. Holttumii*, but is distinguished by the short sori close to the edge, the very short indistinct recurrent veins, and the thicker texture.

MARATTIA SMITH.

- M. pellucida** Pr. ?—Tenompok, in forest by stream (H. 25391, Cl. 27428, 30459).

If rightly named, new to Borneo.

SCHIZÆACEÆ.

SCHIZAEA SMITH.

S. malaccana Baker var. **robustior** var. nov.—Leaves up to 25 cm. long by 1 mm. or more wide, spikes 6–7–jugate, usually folded together. Superficially resembling *S. fistulosa*, especially the Hawaiian subspecies *S. robusta* Bak. but agreeing with the type in all important characters.

Marei Parei ridge (Cl. 10919; Gibbs 4039?, an seq.?).

Typical *malaccana*, common in Sarawak, has as a rule much narrower leaves. This species (of which *S. papuana* Brause, Engler's Bot. Jahrb. 56: 211. 1920, is a direct synonym) can easily be distinguished from the following by the yellowish-brown and flat hairs of the rhizome and the subcomplanate fronds.

S. fistulosa Labill.—*S. malaccana* Baker 1879: 44.—s.l. (Burbidge, Haslam), Pakka to Lobang, terrestrial in open forest (Cl. 10591, 10729, H. 25505), rocky ridge below Pakka (Cl. 27952, 28035).

Hairs of the rhizome glossy, castaneous, the spikes 10–15–jugate, the leaves terete, rush-like.

S. digitata (L.) Sw.—Dallas (Cl. 27357).

S. dichotoma (L.) Sm.—Ridge S. of Koung, 3000 ft. (Cl., s.n.).

LYGODIUM SWARTZ.

L. circinnatum (Burm.) Sw.—Lobang to Kiau (Tp. 1800), Dallas (Cl. 26451).

L. scandens (L.) Sw.—Kiau (Topping 1509).

GLEICHENIACEÆ.

GLEICHENIA SMITH.

G. microphylla R. Br. var. **semivestita** (Labill.) v.A.v.R. Handb. Suppl. 80.—*G. vulcanica* Gepp 205.—s.l. (Haviland 1483), Kamborangah (Gibbs 4158, Tp. 1648, Cl. 10353), Marei Parei ridge (Gibbs 4086, Cl. 10947), Pakka (H. 25510), above Kamborangah (Cl. 28015).

I follow v.A.v.R. in naming this fern, which is common on the loftier mountains of the Malayan region, though it is not quite identical with Australian type. Copeland quoted Kinabalu as a locality for *G. vulcanica* Bl., probably on the basis of Gepp's wrong identification of Miss Gibbs' specimens.

This fern is frequent on the Kamborangah ridge in low open forest, especially in the most open places; sometimes it is associated with the next species.

G. borneensis (Bak.) C. Chr. n. sp. *G. circinnata* var. *borneensis* Bak. Journ. Bot. 1879: 37. Cop. Keys: 303.—*Eugleichenia* a specie antecedente differt: Stipite rachibusque subtus teretibus superne planis vel late sulcatis, rachibus secundariis paleis atrocastaneis, scutelliformibus, subbullatis, integris parce onustis. Segmentis minimis, 0.5 mm. longis et latis, marginibus revolutis, subtus glaucis et paleis orbicularibus vel interdum breviter cuspidatis arcte adpressis conspersis. Sori profunde immersis.

KINABALU: s.l. (Burbidge, type, Kew), to above Pakka and Kamborangah (Gibbs 4226, 4231), below Pakka, open places on ridge (H. 25517, Cl. 27470).—Summit of Mt. Murud (Mjöberg).

This is a very remarkable and distinct species, so different from all others that it might very naturally be regarded as the type of a special section of *Eugleichenia*. It has the immersed sori and the flat upperside of stipe and rachises in common with the South African *G. polypodioides* (L.) Sm., but the scales are wholly peculiar. Those of the under side of the rachises of the branches are ovate, entire, vaulted, glossy and nearly black with paler margins, deciduous and often all abraded, those of the under side of the segments firmly appressed to the leaf, mostly orbicular, sometimes shortly cuspidate, entire, somewhat vaulted, reddish brown with paler margins; they are irregularly scattered over the surface, mostly 3–6 in each segment, and recall a kind of Coccidæ. The other characters are less peculiar. The rhizome is horizontally wide-creeping, brown, glossy, terete, with some scales like those of the rachises, soon naked; the stipe 8–15 cm. long; the frond up to 40 cm. long, unbranched or forked with the terminal bud dormant or growing out to an unbranched pinna on a stalk 15 cm. long without pinnules; lateral branches stiffly erect, up to 30 cm. long, 3–5 cm. broad, with pinnules to the base, unbranched or forked. Pinnules and segments in shape and size like those of *G. microphylla*. Sori with 2–4 very deeply immersed sporangia, one (always?) to each segment, basal on the anterior side.

This species grows alongside *G. microphylla*, and also alone, especially in open places on the ridge. It is sometimes associated with very dwarf *Dipteris*.

G. hirta Bl.—*G. vestita* var. *paleacea* Bak. Journ. Bot. 1879: 38—*G. vestita*, *G. Hallieri*, *G. Warburgii* Copel. Keys 304.—s.l. (Burbidge, Gibbs 4269), Pakka to Lobang (Tp. 1755), Kamborangah (Cl. 10531, H. 25449), Tenompok (Cl. 28785), above Kamborangah on rocks (Cl. 28016).

All specimens named by various authors *G. vestita* belong to *G. hirta*, which is well characterised by its usually very glaucous under surface, by its much narrower fimbriate scales of the midribs and especially by the segments being distinctly toothed at their tips. The specimens from Mt. Kinabalu are more densely chaffy than most others, and might be named var. *paleacea* (Bak.).

G. lævigata (Willd.) Hk.—Kiau (Gibbs 3966, t. Gepp), Koug (H., s.n.).

Associated with *G. linearis* in thickets beside paths on the lower slopes of the mountain.

G. linearis (Burm.) Clarke—Tenompok to Lumu Lumu (H. 25438), Marei Parei ridge (H. 25617), Tenompok (Cl. 29535, 28745).

These collections represent four distinct varieties.

G. bullata Moore—*G. arachnoides* Gepp p. 205.—s.l. (Low, type!, Haviland 1950, Gibbs 3081, Cl. 10724), Lumu Lumu to Kamborangah (H. 25450).—Mt. Tibang (Mjöberg).

This very distinct, thickly coriaceous and densely chaffy species may be identical with the Javanese *G. arachnoides* Mett., but scarcely with *G. volubilis* Jungh., to which v.A.v.R. (Handb. Suppl. 83) referred it. It grows with *G. glauca* in open places on the ridge from about 6000 ft. upwards as far as there is any continuous vegetation, in very exposed places often very much dwarfed.

G. Norrisii Mett.—Tenompok (H. 25405, Cl. 28267, 29430). var. *floccigera* var. nov.—A typo fere glabro differt: costis

nervisque paleis filiformibus stellatis subtus plus minusve villosis, receptaculis itaque dense villosis, sporangiis (plerumque 5–6) juvenilibus a tomento tectis, segmentis non vel leviter emarginatis.

Gurulau spur (Gibbs 3976), Kiau (Cl. 9986).

This variety should be compared with *G. Elmeri* Copel.

The collections of Holttum and Clemens from Tenompok all agree closely with typical material from the Malay Peninsula. They show a few hairs mixed with the sporangia, especially in young sori. In the Peninsula the species is usually found at about 2000 ft. altitude, and has never been found much higher; it is therefore interesting to find it at nearly 5000 ft. on Kinabalu. (R.E.H.).

G. glauca (Thbg.) Hk. var. *longissima* (Bl.).—Lumu Lumu to Kamborangah (Gibbs 4256, H. 25448).

HYMENOPHYLLACEÆ.

HYMENOPHYLLUM J. E. SMITH.

H. microchilum (Bak.) C. Chr. Mitt. Inst. Allg. Bot. Hamburg 7: 143. 1928. *Trichomanes microchilum*

Bak. 1894: 250.—*H. Blumeanum* Copel. Keys 307 (part)—s.l. (Haviland 1478, type !), from Tenompok to Lumu Lumu and Kamborangah, on trees (H. 25470, 25735, Cl. 28984, 27070).—Sarawak, Mt. Dulit (Mjöberg).—Dutch Borneo, Bukit Mehepit and Bukit Rajah (Hans Winkler 744, 1042a).

A genuine species of *Hymenophyllum*, in general habit closely resembling *H. polyanthos* Sw., but the sori are different, broadly ovate and deeply immersed in the segment with two small free triangular lips and exserted receptacle. Fronds quite glabrous, the segments entire, the stipe winged in the upper half. Known from Borneo only.

H. Blumeanum Spr. sens. lat.—Tenompok (Cl., s.n.).

H. eximium Kunze.—*H. formosum* Bak. 1879: 38.—s.l. (Burbidge, Enriquez 18121), Kamborangah (Cl. 10528, 28010, 28012), Tenompok (H. 25424, Cl. 27791, 26948, 29488), Lumu trail (Cl. 28388), falls above Lumu, on rocks (Cl. 29715).

H. pachydermicum Cesati.—*H. vestitum* Bak. Kew Bull. 1894: 7; *Trichomanes vortitum* Hose p. 39 (err. typ.).—*H. Clemensiae* Copel. Phil. Journ. Sci. 12C: 46. 1917.—Kiau (Cl. 10226), Gurulau spur (Tp. 1619, Cl. 10780), Tenompok to Lumu Lumu (H. 25426), Tenompok (Cl. 29270), near Menetendok (H. 25580), Marei Parei ridge (H. 25618).

All writers have failed to identify Cesati's species because of a misprint in the original description, where the measure "duo decimetra longa" should be "centimetra" (t. sp. orig. Herb. Firenze). It is a small species, distinguished by the numerous reddish hairs on the ribs beneath. It seems to be common in Sarawak, and is also found in South-east Borneo: W. Kutai, Kemul (Endert 3799). *H. pilosum* v.A.v.R., from Sumatra (Barisan Mts., Matthew) and Celebes (Kjellberg 3628) is, I think, the same species.

H. paniculiflorum Presl.—Pakka, on rocks by stream in a mass of bryophytes (H. 25497), above Lumu Lumu (Cl. 28014). New to Borneo.

H. australe Willd.—Pakka, on rock near stream (H. 25501), Tenompok, on tree in forest (H. 25734, small form).

var. *fimbriatum* J. Sm.—Tenompok (Cl. 27425).

H. pilosissimum C. Chr. sp. nov.—*H. obtusum* Bak. 1879: 38, Copel, Keys 307.—*H. obtuso* Hook. et Arn. Hawaiian species proxima et cum ea ab auctoribus false conjuncta, differt: majori; stipite exalato ad 3–4 cm. longo; lamina elongato-lanceolata, ad 10 cm. longa, 2 cm. lata, bipinnata-tripinnatifida, supra sparse subtus densissime pilis stellatis molliter lanosa, rachi costique late alatis, segmentis 1 mm. latis.

Kinabalu, s.l. (Burbidge, type, Kew), Lumu Lumu to Kamborangah, on under sides of sloping tree trunks in mossy forest (H. 25460), Kamborangah (Cl. 28983).—Dutch Borneo: Kemul (Enderit 4232, p.p.).—Papua: Hunsteinspitze (Ledermann 8460).

Among the species of the group of *H. ciliatum*, this is perhaps the most densely hairy. The undersurface is throughout covered with stellate hairs which bear, on the tip of a central stalk, 4–6 simple horizontal or suberect branches. In *H. obtusum* the midrib and margins only bear the stellate hairs; our species is more narrowly lanceolate in outline, somewhat narrowed toward the base and the apex, though the apex may be sometimes rounded-obtuse. The sori are placed on the tips of the upper segments, the indusia almost as wide as the segments, divided nearly to the base, the valves rounded, densely hairy, sporangia very large.

To this species belong, I think, all other Malayan and Melanesian specimens called by other authors *H. obtusum* and *H. subtilissimum*.

H. badium Hk. et Grev.—Dallas, on rocks by stream, 2500 ft. (Cl. 27315). Sterile specimens.

H. productum Kze.—Tenompok, on mossy stump (Cl. 28228).

LEPTOCIONIUM.

H. johorense Holttum Gard. Bull. S.S. 4: 408. 1929.—Below Pakka, on tree trunk (H. 25482, det. Holttum). New to Borneo.

The least divided *Leptocionium*, not at all related to *H. borneense* Hook. as suggested by Holttum but very near and perhaps the same as *H. perparvulum* v.A.v.R. Bull. Jard. Bot. Buit. II Ser. no. XVI: 18. 1914, from Mt. Singgalang, Sumatra (Matthew 664). From *H. Lobbii* Moore (syn. *H. subflabellatum* Cesati, *Trichomanes serrulatum* Bak.) it differs chiefly by its segments being twice as wide. It may be noted that Moore's and Baker's species were both based on the same collection made by Lobb in 1857 on Lobong Peak, N. E. Borneo; the locality Moulmein quoted by van den Bosch is due to a wrong label at Kew.

H. blandum Racib.—Marei Parei ridge (Gibbs 4228, H. 25605).

H. perfissum Copel. 1917. 47.—Pakka (Cl. 10588).

H. holochilum (v.d.B.) C. Chr.—Pakka to Lobang (Tp. 1680, 1731).

H. Bakeri Copeland, Keys 309.—*Trichomanes denticulatum* Bak.—Pakka to Lobang (Tp. 1733).

Baker's species was wrongly identified with a quite different Samoan plant (*H. praetervisum*) by Christ. The specimens from Kinabalu are sterile, but I think that they belong here. *H. Bakeri* resembles in general habit, size and sori *H. microchilum*, but the segments are remotely toothed and the rachis furnished with a few hairs.

H. Lobbii Moore—*Trichomanes serrulatum* Bak.—Kamborangah (Cl. 28006).

H. serrulatum (Pr.) C. Chr.—Gurulau spur (Tp. 1617, Cl. 10779), Tenompok (H. 25421, Cl. 26850, 28088), Trail to Lumu (Cl. 28386), Bungal to Kalawat, 3000 ft. (Cl. 28174). Very common on mossy trees.

H. thuidium Harr.—*H. physocarpum* Christ.—Dallas-Tenompok ridge (Cl. 26897a), Tenompok (H. 25392).

New to Borneo. The specimens are rather small, but otherwise match the type from Panay (Kew). It is very near *H. Reinwardtii* v.d.B. Hym. Jav. pl. 42, and perhaps only a variety of that species, differing in its narrower very much crisped fronds and faintly crenate valves. It is intermediate in its characters between *Euhymenophyllum* and *Leptocionium*; its whole habit is that of the crisped species of the latter section, especially *H. Neesii* and *H. cardunculus*, but the sori are quite different, globose, thick and subbullate, much broader than the segments, the round valves naked on the back, their margins obscurely crenate. The stipe is broadly crisped-alate like the rachis, the segments faintly toothed.—The Papuan *H. physocarpum* (Schlechter 14529, Ledermann 13050a, Berlin) is a slightly different form with the valves more coarsely toothed.

H. denticulatum Sw.—Lobang to Kamborangah (Tp. 1645), Marei Parei ridge (Tp. 1881, Cl. 11042 p.p.).

H. Neesii (Bl.) Hk.—s.l. (Low, Burbidge, Enriquez Herb. Singap. 18125), Lobang to Pakka (Gibbs 4144), Marei Parei ridge (Cl. 11042 p.p.), below Kamborangah (Cl. 28008), Tenompok to Lumu Lumu (H. 25425, Cl. 28386), Tenompok (Cl. 28087, 28084), Silau basin (Cl. 28397).

H. fraternum Gepp p. 196 (Gibbs 4071) is, I think, a scanty and poorly fertile specimen of *H. Neesii*.

H. cardunculus C. Chr. Mitt. Inst. allg. Bot. Hamburg 7: 144. 1928.—*H. aculeatum* Gepp p. 197.—Gurulau spur (Gibbs 4020), Dallas to Tenompok, on trees (H. 25351), Silau basin 8000 ft. (Cl. 29027).

This species is very near *Leptocionium acanthoides* v.d.B. Hym. Jav. pl. 32 (syn. *H. sabinifolium* Bak.), differing in the rather densely reddish pilose stipe and rachis.

TRICHOMANES LINN.

- T.** (*Gonocormus*) **minutum** Bl.—*T. proliferum* Gepp p. 195.—Gurulau spur (Gibbs 4019).
T. (*Gonocormus*) **proliferum** Bl.—Gurulau spur (Tp. 1616), Tenompok to Lumu Lumu, on mossy tree trunk (H. 25434).
T. (*Gonocormus*) **Teysmanni** v.d.B.—near Pakka, on rock by stream (H. 25498).

I am possibly wrong in referring H. 25498 and other Bornean specimens to this species. In general habit and size they resemble *T. pyxidiferum*, and many Malayan specimens in herbaria belonging here are placed under that name; but their thread-fine stipe, their colour and the structure of the somewhat plicate fronds show a close resemblance to the species of *Gonocormus*. They are, however, apparently not proliferous, but on close examination small hairy buds may be found on the upper part of the stipe.

- T. dichotomum** Kunze.—*T. digitatum* Bak. 1879: 38.—*T. nitidulum* Gepp p. 195, Copel. Keys 312.—s.l. (Burbidge), Pakka (Gibbs 4233, Tp. 1709), Kamborangah to Pakka (H. 25475), Tenompok to Kamborangah (Cl. 28003).

There is evidently only one species of the group of *T. digitatum* occurring on Kinabalu; Miss Gibbs' specimens are small and digitately divided, more resembling *T. nitidulum* v.d.B., but Mr. Holttum's fine specimens consist partly of similar small fronds, partly of some which are much larger and very well agree with the Javanese type (v.d.B. Hym. Jav. pl. 16). In its often much prolonged and remotely pinnate fronds *T. dichotomum* is abundantly different from the genuine *T. digitatum* Sw., which in my opinion does not occur in Malaya. In Borneo this species has hitherto been found on Mt. Kinabalu only.

- T. palmatifidum** K. Mueller.—*Hymenophyllum borneense* Hk.—Pakka (Tp. 1725), Lumu Lumu to Kamborangah, on tree trunk (H. 25462), Silau basin at 10,000 ft. (Cl. 28207), Masilau (Cl. 29281).

This is the Bornean fern described by Hooker; it differs a little from the Javanese type by the somewhat narrower segments but it is certainly not specifically different.

- T. humile** Forst.—Below Dallas, on rock by stream (H. 25375, Cl. 27138).
T. bilabiatum Nees et Bl.—Lobang, on vertical rock in forest (Tp. 1779, H. 25554), Tenompok (Cl. 26858).
T. bipunctatum Poir. *sens. lat.*—*T. filicula* Bak. 1879: 38.—s.l. (Burbidge), Lobang to Kiau (Tp. 1799, 1806, Cl. 9955), Tenompok, on tree by stream (H. 25400, Cl.

27119, 28302, 28421, 27756 bis, 28232), Dallas to Tenompok (Cl. 27588), near Kabayau (H. 25627).

- T. brevipes** Baker.—*T. pyxidiferum* Bak. 1879: 38.—*T. recedens* Rosenst.—*T. microlirion* Copel.—s.l. (Burbidge), near Dallas on small trees near stream (H. 25142, Cl. s.n.).

The sori are often confined to the uppermost, much abbreviated pinnae, forming a terminal spike (*T. microlirion* Copel.). Copeland would refer these plants to *T. christii* (Phil. Journ. Sci. 51: 185).

- T. pallidum** Bl.—s.l. (Burbidge, t. Baker, not seen, an seq. ?), near Lumu Lumu (H. 25733).

- T. album** Bl.—*T. pallidum* Gepp p. 196.—s.l. (Gibbs 4113), Lumu Lumu to Kamborangah, on lower sides of sloping tree trunks (H. 25468, Cl. 28007).

T. pallidum and *T. album*, though differing widely in pubescence, are united by almost all authors. The hairs of *T. pallidum* are rather few, long and slender, patent; those of *T. album* numerous, straw-coloured, rather stiff and appressed to the surface (see v.d.B., Hym. Jav. pl. 7–8). *T. pallidum* is on the whole a lowland species; *T. album* occurs only on mountains at rather high elevations.

- T. auriculatum** Bl.—Kiau to Lobang (Tp. 1639), Tenompok (Cl. 29347), Dallas-Tenompok ridge (Cl. 27736). Usually on trees.

- T. maximum** Bl.—s.l. (Low, Burbidge, Gibbs 4036), Marei Parei ridge (Cl. 10911), Kamborangah, near stream in forest (H. 25541), Tenompok, (Cl. 28372, 28225a), Dallas-Tenompok ridge, in ravine (Cl. 26897), Silau basin, rocks in stream bed (Cl. 29067).

This fine species is nearly always found on wet rocks near streams.

- T. papillatum** K. Mueller ?—Tenompok to Lumu Lumu, bank of small stream, by water's edge (H. 25430, Cl. 27427, 28225, 28229, 28459, 28740).

H. 25430 is exactly matched by collections from stream sides at similar elevations in the Peninsula. They are distinguished from typical *T. cupressoides* by their more slender habit, narrower fronds with more ascending pinnae. Their appearance in the field is distinctive, but in the herbarium it is difficult to find definite characters to separate them from *T. cupressoides*. It is possible that their peculiar form is a result of their position of growth, in a zone just above normal water level (often among tree roots) in the earth (not rocky) banks of very shady streams; they must be subject to immersion by floods at fairly frequent intervals. I have seen them abundantly

beside three different streams in the Peninsula at about 4000 to 5000 feet elevation. [R.E.H.].

T. cupressoides Desvaux.—*T. rigidum* auctt. ex p.—Marei Parei ridge (Cl. 11061), Tenompok, by stream in forest (H. 25401), Tenompok to Kamborangah (Cl. 28011).

T. apiifolium Presl. (not Baker 1879).—Tenompok, on rocks by stream (H. 25396, Cl. 28227).

T. Schlechteri Brause, Engler's Bot. Jahrb. 49: 10 1912. var. ?—*T. apiifolium* Baker 1879: 38.—s.l. (Burbidge).—Dutch Borneo: Kemul (Endert 4261).

A very interesting species with reddish-brown, very compact, large fronds, resembling an ostrich-feather, the stipe and rachis long-hairy. The type is from New Guinea. *T. compactum* v.A.v.R. (Nova Guinea 8: 57) is probably a form of the same. I hope to deal in another place with these three forms which seem to be somewhat different in anatomical structure.

T. pluma Hook.—*T. trichophyllum* Moore.—s.l. (Low, Burbidge), Marei Parei ridge (Cl. 11056), Lumu Lumu to Kamborangah, on ground in forest, occasional (H. 25469, Cl. 28013, 28985, 27071, Enriquez 18157).

I cannot see any difference between the two "species" here united.

Trichomanes javanicum Gepp p. 197 (Gibbs 3109) is *Asplenium fuliginosum*.

CYATHEACEÆ.

I follow Copeland in uniting all Malayan tree-ferns in one genus, *Cyathea*, but I arrange the species otherwise, according to the results arrived at during my comparative studies of practically all specimens collected in Borneo, including all types. In another paper I hope to show how the species may be arranged in more distinct groups.

C. capitata Copel. 1917: 49.—Marei Parei ridge (Cl. 11033), Falls above Lumu (Cl. 29987), Lumu Lumu, by stream in forest, caudex 30 cm. high (H. 25447; also Cl. 29109, 27954).—Sarawak: Mt. Murud (Mjöberg).—A very distinct species.

C. kinabaluensis Copel. 1917: 51.—Gurulau spur (Cl. 10840, 10861, Tp. 1634), forest ridges, 4000–5000 ft. (Cl. 27331), Dallas-Tenompok ridge, forest ravine (Cl. 26824).

Perhaps a local race of *C. arthropoda* Copel. from Sarawak (Bongo Range, Mt. Poi). Clemens 26824 shows distinct narrow indusia round the bases of the sori.

C. (Alsophila) vexans (Ces.) C. Chr. comb. nov. *Alsophila vexans* Cesati, Atti Acad. Napoli 7, part 8: 4. 1876.—

A. dubia Bedd. *Cyathea dubia* Copel. Keys 349.—Marei Parei ridge (Cl. 10921).

To this species belong probably all Bornean specimens referred by authors to *Alsophila glabra* (Bl.) Hook.

Cyathea alternans (Wall.) Pr.—Bungal Hills, 3,000 ft. (Cl. 29160).

This specimen exactly matches material from the Peninsula, except that it appears to be quite exindusiate. The Peninsular plants of this species are very variable in the extent of the development of the indusia, but all which I have examined show at least a small indusium (R.E.H.).

C. polypoda Baker.—s.l. (Haviland 1479).

This species differs from the following one in these characters: the sori are indusiate, and the costæ and midribs beneath bear crowded pale bullate scales. I am doubtful however whether the two species are really distinct. Further material is required.

C. (Alsophila) kemberangana Copel. 1917: 52.—Kam-borangah, in more open places in forest (Cl. 10500, H. 25458), jungle ridge above Lumu (Cl. 27954).

Described from a rather incomplete, old frond. From Mr. Holttum's better specimens I add some supplementary notes. Base of stipe with a mass of pale straw-coloured, narrow long-acuminate, minutely ciliate 2–3 cm. long scales, stipe and rachises brown, without scales and hairs, costæ and costules hirsute above, glabrous beneath, midribs of segments with some brown bullate scales beneath. Pinnæ long-stalked, up to 40 cm. long by 13 cm. wide, pinnules on petioles 5 mm. long, articulated to costa, 6 cm. long, 1.5 cm. wide, texture moderately firm (coriaceous in the old type).

This may be the same as *C. polypoda* Bak., but it is apparently exindusiate and the bullate scales much fewer and not pale. It is intermediate between *C. vexans* and *C. squamulata*, but quite distinct in the pale basal scales and the stipitate articulated pinnules which are much deeper incised than in the former species.

A fairly common small tree fern on the ridge at about 6000–7000 ft. This species has also been collected in the Malay Peninsula (R.E.H.).

C. (Alsophila) squamulata (Bl.) Copel.—*Alsophila Ridleyi* Baker.—*Cyathea elliptica* Copel. 1917: 51.—Gurulau spur (Cl. 10859).

C. elliptica seems to me quite identical with the co-type of *A. Ridleyi* (Ridley 4401) in the Singapore Herbarium; it is very slightly different from typical *C. squamulata*, and perhaps only young though fertile plants of it. A specimen from Tenompok (Cl., s.n.) is bipinnatifid only. This resembles *Alsophila parvifolia* Holttum from Sumatra in

size, cutting, paleaceous stipe and rachis with bristles below, but is hardly that species. The costæ have whitish bullate scales beneath, and no hairs. I have little doubt that it is a young fertile state of the form of *C. squamulata* described as *C. elliptica* Copel.

C. (Alsophila) **Burbidgei** (Bak.) Copel.—*Alsophila Margarethae* Schroeter.—*Cyathea mollis* Copel. 1917: 52.—Gurulau spur (Tp. 1842, Cl. 10839), Tenompok (Cl. 29569), Dallas-Tenompok spur (Cl. 27741).

Found in several places in Borneo, and I have the same from the Malay Peninsula: Negri Sembilan, Bukit Tangga (Herb. Singapore no. 11830). It is closely related to *C. squamulata*, but the rachises and ribs are more or less hirsute beneath.

C. (Alsophila) **ramispina** (Hook.) Copel. Phil. Journ. Sci. 4C: 36. 1909. *Alsophila ramispina* Hook., Index.—*A. glabra* Baker 1879: 38.—*A. amaiambitensis* and *A. Hallieri* (not Rosenstock) v.A.v.R. Bull. Jard. Bot. Buit. II Ser. no. XXVIII: 1–2. 1918.—*A. kenepaiana* v.A.v.R. l.c. III Ser. 2: 129. 1920.—Lumu Lumu to Kamborangah, abundant in forest on the ridge (H. 25457), ridges above Tenompok (Cl. 28850, 29491).

This is the oldest known species of a special group of *Alsophila* of which several closely related species are now known, e.g. *C. recommutata* Copel, *C. Kingii* (Clarke) Copel., *C. dimorpha* Copel.; it is characterised by dark-coloured rachises, often much contracted fertile pinnules and by the presence of aphlebioid pinnæ at the base of the stipes (these are however absent in *C. Kingii*). The group is, I think, most nearly related to the group of *C. squamulata*. Strangely enough, all species of *Alsophila* found in Madagascar belong to the same group. *C. ramispina* is known from Borneo only, but is there widespread. It is variable, and it seems that each mountain has its own form, which I cannot, however, regard as distinct species. I refer to it all forms with not contracted fertile pinnules, with the rachises dark brown, not black, and with small bipinnate aphlebiæ which remain as branched spines when the pinnules are fallen. The form from Kinabalu is sub-bipinnate with the segments more spaced than in the type, the costules and midribs beneath with crowded, brown, sub-bullate scales. The aphlebiæ are at first green, but soon turn brown; those of the old leaf-bases persist and clothe the trunks of the larger ferns in a remarkable way.

C. (Alsophila) **recommutata** Copel. Phil. Journ. Sci. 4C: 36. 1909.—*Alsophila commutata* Mett., C. Chr. Index.—*Cyathea Toppingii* Copel. 1917: 51.—Gurulau spur (Tp. 1824), in forest (H. 25408, Cl. 28266, 28596).—

Sarawak: Mt. Penrissen (Brooks 60), Mt. Dulit (Mjöberg).

The specimens from Kinabalu are perfectly identical with those from Mt. Dulit, which I have compared with the type of *A. commutata* from Mt. Ophir (Cuming 396, Berlin) without being able to find any reliable differences between them. The species is very near *C. ramispina*, agreeing with it in texture, colour, and scales. The sterile pinnæ are hardly different, but the fertile pinnules are much contracted, often 5 mm. broad only, incised half-way into triangular obtuse toothed lobes with simple veins and small sori close to the midrib. I find another difference in the basal aphlebiæ which are simply pinnate with the pinnæ soon dropping, leaving the lower portion of the rachis as strong, 2 to 3 cm. long, *unbranched* spines. *C. Hewittii* Copel. from Bongo Range, Sarawak, is to me a form of the same species.

C. paleacea Copel. 1917: 53.—Pakka to Lobang (Cl. 10726, Tp. 1669).

A doubtful species, perhaps a dwarf form of *C. Havilandii*, with the same dense vestiture of scales, but it is much smaller and bipinnatifid only or bipinnate with entire pinnules.

From Copeland's remarks and from examination of plants in the field I feel fairly certain that this is an immature form of *C. Havilandii*, which species is very abundant in the low open *Leptospermum*-*Dacrydium* forest on the ridge at about 9000 ft. altitude. The plants have very short erect stocks, never tall stems. I saw no evidence of the presence of a second species. Though *Cyathea* plants are not usually fertile until they have attained their full adult size and leaf-differentiation, I have come across cases in three different species of fertile plants with leaves only bipinnatifid (adult plants being bipinnate-tripinnatifid), and this may be a similar case (R.E.H.).

C. Havilandii Baker 1894: 249.—*C. rigida* Copel. 1917: 53.—*C. dulitensis* Gepp p. 197.—s.l. (Haviland 1485), below Pakka, abundant in low forest on ridge (Gibbs 4280?, Tp. 1758, H. 25509, Cl. 27956, 29805).

A very distinct species, known from Kinabalu only. Trunk short, stipe, rachis and all ribs clothed beneath with a mass of brown scales. Stipe short, very stout, the lamina ovate, about 50 cm. long, 25 cm. wide, rigidly coriaceous. Gibbs 4280 is a scrap, certainly not *C. dulitensis* but probably this.

C. megalosora Copel. 1917: 54.—*Alsophila crinita* Gepp p. 197, *Cyathea crinita* Copel. Keys 351.—Kamborangan to Pakka (Gibbs 4237), Pakka to Lobang (Tp. 1759), Silau basin at 8000 ft. (Cl. 29068, 29714).

Near the Javanese *Alsophila tomentosa* Bl. but the scales entire, not woolly fimbriate, and the indusia large, persistent, thin.

C. Korthalsii Mett.—Kamborangah, by small stream (H. 25527), Silau basin 8000 ft. (Cl. 29712). New to Borneo.

The specimen agrees, as to size, shape, scales, veins and sori, exactly with the type from Sumatra, so that I believe my identification is correct. It is a tall tree-fern (to 30 feet), the leaves practically sessile on old plants, being narrowed below almost to the base of the stipe which is clothed with a mass of very narrow, pale brown, rather harsh scales. Younger plants have stipitate leaves. In general, not unlike *C. latebrosa*, but indusia persistent.

C. (Alsophila) latebrosa (Wall.) Copel. Phil. Journ. Sci. 4C: 52. 1909. *Alsophila* Wall., C. Chr. Index.—Dallas to Koung, abundant in secondary forest (H. 25625), in forest, Tenompok (H. 25407), Dallas-Tenompok ridge (Cl. 27414, 28158).

C. longipes Copel. 1917: 54.—Marei Parei spur (Cl. 10915), Penibukan ridge, in ridge forest (H. 25601).

A distinct species, in its long-stalked pinnules superficially resembling *C. polypoda* but very different in its sharply serrate falcate segments. The slender stipe, which may attain 2 m. in length, is strongly muricate.

C. (Alsophila) contaminans (Wall.) Copel. Phil. Journ. Sci. 4C: 60.—*Alsophila glauca* (Bl.) J. Sm., C. Chr. Index.—*Cyathed celebica* Gepp p. 197.—s.l. (Low), Kiau (Gibbs 3965, 3988, Cl. 10236, 10446), Dallas, abundant in valleys by streams (H. s.n., Cl. 26861), ridge above Koung at 3000 ft. (Cl. 29108).

var. **setulosa** Hasskarl Journ. Bot. 7: 324. 1855.—Lobang, by stream 30 ft. tall (H. 25560).

Ribs with long whitish hairs beneath. This form seems to be the commonest in Borneo, and some of the specimens quoted above (e.g. Gibbs 3988, = *C. celebica* Gepp) probably belong here.

C. tripinnata Copel. Phil. Journ. Sci. 1 Suppl. 251. 1906; 4C: 39.—Tenompok (H. 25409, Cl. 27937, 28695, 29395, 28079). New to Borneo, known previously from the Philippines.

Holtum's specimen agrees very well with the type, differing a little in the rachis being slightly muricate, but the stipe is furnished with many black, short and sharp spines as in the type. The caudex is very stout and the young fronds are covered with large pale chaffy scales. The species is totally different from the other tree-ferns of Kinabalu, but closely related to some other Malayan species, e.g. *C. Teysmannii* Copel. (*C. celebica* v.A.v.R.) which is

certainly the same as *Alsophila ? celebica* Mett. (t. sp. det. Mett.) but probably not *C. celebica* Bl. Copeland listed *C. Teysmannii* as a Kinabalu fern (Keys 350), but it is not in the collections received from him, so that I suppose his record is based on Gepp's wrong identification of Gibbs 3988, which is *C. contaminans*.

MATONIACEÆ.

Matonia Foxworthyi Copel. Phil. Journ. Sci. 3C: 343, pl. 2. 1908.—Marei Parei ridge, edge of forest (H. 25619), below Kamborangah (Cl. 28460).

All specimens from Borneo (Sarawak: Matang, Beccari, Hose 13; Santubong, Matthew; Mt. Poi, Foxworthy 372, 373, Mjöberg. Dutch Borneo: G. Klam, Hallier 2420) belong to this species, which must be regarded as a geographical variety of *M. pectinata* R. Br.

The distinction of *M. Foxworthyi* from *M. pectinata* is not however so clear as Copeland supposed. When he described the former species he had for comparison only specimens of *M. pectinata* with short falcate segments. I have since collected on G. Tahan, in the Malay Peninsula, specimens of *Matonia* which are very little different from Bornean specimens, equalling the latter in length of segments and number of sori (up to 6 on each side of the costa), differing only slightly in the segments being a little more attenuated and slightly more oblique. I obtained also other specimens intermediate between this large form and the commoner small one with rather short falcate segments. It is possible that large size may be connected with particularly favourable growth conditions. It thus appears that *M. pectinata* in the Peninsula has a much greater range of variation than *M. Foxworthyi*, which never produces fronds with short oblique segments. Unfortunately *Matonia* plants are among the most difficult ferns to establish in cultivation, so that it will hardly be possible to verify the differences by cultivation together of plants from various localities. [R.E.H.]

DICKSONIACEÆ.

DICKSONIA L'HÉRITIER.

D. Blumei (Kze) Moore.—Tenompok to Lumu Lumu (H. 25445), Tenompok, flat place in dense jungle (Cl. 28734), Silau basin at 6000 ft. (Cl. 29055). New to Borneo.

The Kinabalu form is rather different from the Javanese type and more nearly resembles the form occurring in the Philippines. It is a very stout tree fern, the stipes

and rachis crinite with cylindrical, deep red-brown, long hairs (a brighter colour on the living plant, which is remarkably handsome), and all ribs beneath densely lanose with soft, pale brown hairs mixed with some cylindrical ones. Perhaps it is a distinct local species.

CIBOTIUM KAULFUSS.

C. Cumingii Kunze var. **arachnoideum** C. Chr. n. var.—A typo Philippinense differt: majore, vix glaucescente, subtus ad costulas pilis longis tenuibus, plerisque antrorsis vel intertextis nec divaricatis instructa et ubique pilis brevibus, pallidis, crispatis arachnoidea, soris per laciniam sæpissime 2-jugis.

Dallas, abundant in old clearings (H. 25378, Cl. 26852), Dallas-Tenompok spur (Cl. 27740), ridge above Koung at 3000 ft. (Cl. 29162), falls above Lumu (Cl. 29672), Gurulau spur (Gibbs 3999?=*C. barometz* Gepp p. 197, Copel, Keys 324).

I now consider *C. Cumingii* a good species which differs from the typical Chinese *C. barometz* by its hirsute axes and by only one pair of sori to each segment. The Kinabalu form is perhaps a distinct local species.

CULCITA PRESL.

Maxon, Journ. Wash. Acad. Sci. 12: 454. 1922. (*Balantium* auctt. Index, not Kaulfuss).

C. Copelandii (Christ) Maxon, l.c., *Dicksonia Copelandii* Chr. Phil. Journ. Sci. 2C: 183. 1907, *Balantium Copelandii* Chr. Copel. Phil. Journ. Sci. 3C: 301, 4C: 62, pl. 19; Keys 335.—Kiau (Tp. 1526, det. Copeland), Tenompok (Cl. 27742). *Balantium pilosum* Copel. Journ. Straits Br. R. Asiatic Soc. 63: 71. 1912 is very likely the same species, but I have seen no specimen for comparison.

POLYPODIACEÆ.

PLAGIOGYRIA (KUNZE) METT.

P. pycnophylla (Kze) Mett.—Pakka (Cl. 10590), in rock crevices, almost to summit (H. 25491, Cl. 28960), Low's Peak, between rocks (Cl. 27043).

P. tuberculata Copeland Phil. Journ. Sci. 1 Suppl. 153. 1906; 38: 391.—*P. sumtrana* Rosenst. in Fedde Repert. 13: 214. 1915.—*P. subrigida* v.A.v.R. Bull. Jard. bot. Buit. III Ser. 2: 163. 1920.—*P. rotundipinnata* Bonap. Notes Pterid. 14: 484. 1923.—*P. pycnophylla* var. *integra* subvar. *stenophylla* Bonap. l.c.—*P. integrispinnata* Bonap. l.c. p. 60.

I find in my notes to this species the locality Kinabalu, but unfortunately I have quoted no specimen. It is however highly probable that it occurs there, as it seems to be widely distributed in the Malayan region. I have compared all the types of the species quoted as synonyms and am sure that all belong to this species, which differs from *P. pycnophylla* by its entire pinnæ.

P. glauca (Bl.) Mett.—Marei Parei ridge (Cl. 11070, H. s.n.), at 12000 ft. (Cl. 28385), Dachang (Cl. 29060), Upper Silau basin (Cl. 29716).

This is apparently a rather high level species, but does not occur commonly on the main Kamborangah ridge. I only saw a few sterile plants at about 6000 ft.

P. Clemensiae Copel. Phil. Journ. Sci. 38: 395. 1929.—Pakka (Cl. 10539, H. 25730), Silau basin at 10000 ft. (Cl. 29059), side of granite dome at 12000 ft. (Cl. 28961), Kamborangah (Cl. 28962).

Intermediate between *P. tuberculata* and *P. adnata*, in colour and coriaceous texture like the former, but resembling the latter in having almost all pinnæ adnate and connected to the rachis by a wing. *P. Clemensiae* is however larger than *P. adnata* (up to 1 m. high) and much more robust, and is also marked by the very thick and flattened rachis. The specimen from Kamborangah is somewhat intermediate in character (see remarks under *P. adnata*).

P. adnata (Bl.) Bedd.—“from 7000 to 12000 ft., abundant where open and dry” (Gibbs 4112), above Tenompok, frequent in ridge forest (H. 25442, Cl. 27960, 28186).

This species occurs only on the lower ridges, and is abundant at 5000 to 6000 ft. altitude. In the neighbourhood of Pakka, at about 10000 ft., *P. Clemensiae* is fairly abundant, and extends upwards so far as there is continuous vegetation. But plants occur at intermediate altitudes all the way up the ridge, and some taken by Clemens at Kamborangah (7000 ft.) are of a rather intermediate character, though nearer to *P. Clemensiae*. I noticed no sudden change as I went up the ridge, and it was only on reaching Pakka that I realised how much bigger the plants were than at lower elevations. It is probable that the two species are distinct enough, but that intermediate (hybrid?) forms occur. Miss Gibbs reached the top of the ridge at Kamborangah, and it is probable that all plants seen by her were *P. Clemensiae* or intermediate forms, not true *P. adnata*. [R.E.H.].

DIACALPE BLUME.

- D. aspidioides** Bl.—Marei Parei spur (Gibbs 3108), Lobang (Cl. 10355), Silau basin, among rocks at 7000 ft. (Cl. 29046).

ACROPHORUS PRESL.

- A. Blumei** Ching nom. nov.—*A. stipellatus* C. Chr. part.—*Aspidium nodosum* Bl. (not Willd.).—Pakka, in forest near stream (H. 25499, Cl. 27753), Silau basin, among sheltered rocks at 7000 ft. (Cl. 29276, 29966), Kamborangah (Cl. 28977), Tenompok (Cl. 28837).

All forms of this genus have hitherto been referred to one species but I fully agree with Mr. Ching in segregating the much more finely divided Malayan form from the Himalayan one to which the name *stipellatus* must be confined; a new name for the Malayan form seems to be needed. It is well marked by several good characters, e.g. the 4-pinnate frond with very small ultimate pinnules, the distinct indusia, the prickly rachises etc.

STENOLEPIA v.A.v.R.

- S. tristis** (Bl.) v.A.v.R. Bull. Dep. Ag. Ind. Néerl. 27: 45. 1909.—St. John's Peak, 13100 ft., far under a rock (Cl. 27958, a very dwarfed specimen), Lumu trail at 7000 ft.? (Cl. 27946), on granite dome among shrubs, at 12000 ft. (Cl. 27049A).

This is a very interesting discovery, the species having been known previously only from high mountains in Java. The Kinabalu specimens are all very small, the largest whole frond not much bigger than a pinna of a typical specimen from Java.

MONACHOSORUM KUNZE.

- M. subdigitatum** (Bl.) Kuhn.—Gurulau spur (Gibbs 3111, 4092), Marei Parei ridge (Cl. 10912), below Kamborangah, on ground, rocky place in forest (H. 25544), falls above Lumu, among rocks (Cl. 29938, 29967).

DENNSTÆDTIA BERNHARDI.

- D. rufidula** C. Chr. n. sp.—Rhizomate breve repente, glabrescente, stipitibus approximatis. Stipite ad 30 cm. longo, cum rachi brunneo, pilis brevibus, articulatis dense (parte rachis superiore densissime) villosa et pilis delapsis rugoso. Lamina lanceolata, ad 70 cm. longa infra medium 25–30 cm. lata, versus basi aliquot angustata, versus apicem sensim attenuata, firmiter herbacea, in siccitate rufidula, utrinque (præsertim infra) pilis articulatis, subcrispatis dense villosa, bipinnata. Pinnis alternis, sessilibus, 2–3 cm. inter se

remotis, maximis 20 cm. longis (infimis 6–7 cm.), 3.5 cm. latis, lanceolatis, acuminatis, latere acroscopico paulo quam basiscopico latiore inæqilateralibus. Pin-nulis ca. 30–jugis, alternis, 4 mm. inter se remotis, patentibus, maximis lateris superioris 2.3 cm. longis (basali superiore paulo longiore), 3 mm. vel paulo ultra latis, basi decurrentibus, antice excisis, obtusis, profunde pinnatifidis, lobis 6–8 utroque latere, oblongis, integris, marginibus subreflexis, acroscopicis quam basiscopicis paulo longioribus (præsertim basali). Venis indistinctis, intra marginem in hydathodas terminantibus. Soris prope sinus inter lorum positus, plerumque sub pilis occultis, indusiis poculiformibus, sæpe reflexis.

KINABALU: near Tenompok, on shady bank by bridle path (H. 25298, type in Herb. C. Chr.; Cl. 26827, 27465, 26977). Plate 51.

A very distinct new species, only to be compared with the Himalayan *D. appendiculata* (Wall.) J. Sm., but not so deeply cut and wholly peculiar in its densely villous fronds.

D. ampla (Bak.) Bedd.—Tenompok, frequent in forest near streams (H. 25406, Cl. 28341, 28281, 29435, 29602).

D. scabra (Wall.) Moore var. *tenuisecta* C. Chr. n. var.—A typo differt: segmentis ad 4 mm. longis et haud 1 mm. latis, distantibus.

The rhizome is densely covered with rusty brown hairs 2–3 mm. long; the stipe finely scabrous, dark purplish at the base, 50 cm. long; the frond 45 cm. long and 20 cm. wide; the rachis light castaneous, fading to yellowish above, polished and slightly scabrous. The basal (largest) pinnæ are 18 cm. long and 9 cm. wide. The ultimate segments are separated by their own width, about 4 mm. long and less than 1 mm. wide, the veins raised beneath, and the texture firmer than that of the type.

Kamborangah (H. 25520). Only two plants found, with one fertile leaf.

D. cuneata (J. Sm.) Moore.—*D. gomphophylla* (Bak.) C. Chr.—Lobang (Tp. 1782), near Tenompok (H. 25289, Cl. 26976).

The type of *D. gomphophylla* from Mt. Matang, Sarawak (Hose 11, Kew) agrees with type of *D. cuneata* var. *obtusa* Copel. Phil. Journ. Sci. 7C: 63. 1912, which variety "it is not worth while to try to distinguish" (Copel. Keys 324). Copeland, following v.A.v.R., distinguished *D. gomphophylla* from *D. cuneata* by its scandent or twining frond, but neither Baker nor Hose describes it as twining and the type specimen has not the appearance of being so. The fronds of the Kinabalu form are erect, pale green, 4 m.

high, the rhizome stout (2.5 cm. diameter), creeping. It is a very striking fern, and evidently not abundant on Kinabalu.

MICROLEPIA PRESL.

M. Hookeriana (Wall.) Presl.—*Nephrolepis* (?) *marginalis* Copel. 1917: 49.—Gurulau spur (Tp. 1632, Herb. Copel.), near Dallas, terrestrial in forest (H. 25138), Tenompok (Cl. 30460, 28092, 27950, 27407).

Holtum's more complete specimen, exactly matching the type of *N. marginalis*, agrees so well with specimens from Himalaya and Tonkin that at best it can be distinguished as a geographical variety, chiefly differing from the type by the lack of long setaceous hairs on the ribs beneath; the under side is however not quite glabrous but furnished with very short scattered hairs. The pinnæ are also less distinctly auriculate. The creeping rhizome is densely clothed with red-brown hairs as in other species of the genus, not scaly as in *Nephrolepis*. According v.A.v.R., *M. Hookeriana* has been found in Sumatra and Java; previously it was known from North-eastern India to South-east China and Tonkin. *Microlepia phanerophlebia* (Bak.) C. Chr., from the latter country, where it seems to be common, is to me the same species.

M. Ridleyi Copel. Phil. Journ. Sci. 11C: 39. 1916.—near Tenompok, terrestrial (H. 25296, Cl. 26978, 26979, 27527 part). New to Borneo.

The specimen agrees with another from Pahang (Burkill 16699), received from Singapore under this name, but I am not at all sure that it may be distinguished from *M. majuscula* Lowe, to which I have referred a specimen from Sarawak (Lundu, Hose 314, at Kew), but which is probably the same. It differs chiefly from other species of the group by its almost completely glabrous fronds.

M. strigosa (Thbg.) Presl.—Gurulau spur (Tp. 1832), near Lobang, in forest near river (H. 25564), near Tenompok (Cl. 27907).

Microlepia manilensis Pr.—Tenompok (Cl. 27527 pt., 28175, 28236, 28570, 28683, 29683, H. 25381), Falls above Lumu (Cl. 29941).

Like all big species of this genus, *M. manilensis* is very variable in the degree of cutting, which depends largely on the age of the individual and the size of the fronds. The species is well marked by the slightly hairy frond, and especially by the large sori with persistent cup-shaped indusia.

This is an abundant species at Tenompok, in wet places on the edge of the forest, and attains a very large size; specimens collected by Clemens are described as 3 to 4

metres high. Young plants of a much smaller size may also be fully fertile.

M. speluncæ (L.) Moore var. *villosissima* C. Chr. Gard. Bull. S.S. 4: 399. 1929.—Kabayau, grassy slopes by rest-house (Cl. 27672), Dallas, ravine (Cl., s.n.).

HYPOLEPIS BERNHARDI.

H. punctata (Thbg.) Mett. (*Dryopteris*, Index).—Dallas to Tenompok, on bank by edge of forest (H. 25299, Cl. 26980), Tenompok (Cl. 29497), Kundasang (Cl. 29239, 29110).—New to Borneo.

In all essential characters typical, but very much larger than East-Asiatic specimens; frond 2 m. high, the pinnæ to 45 cm. long.

H. tenuifolia (Forst.) Bernh.—Kamborangah, edge of river, in a dense fern thicket (H. 25535).

The only Bornean specimen seen by me. It is very like the commonest Polynesian form which differs from *H. punctata* chiefly by the much larger and persistent false indusia. This species has often been recorded from Malaya and continental Asia, but most specimens so named belong either to *H. punctata* or other species; e.g., a specimen from Pahang (G. Tahan, Holttum 20753) which I identify with *H. bivalvis* v.A.v.R. Bull. Jard. Bot. Buit. II Ser. no. XVI: 19. 1914, from G. Sago, Sumatra (Matthew 700).

H. Brooksiae v.A.v.R. Bull. Jard. Bot. Buit. II Ser. no. XXVIII: 29. 1918.—Tenompok, in clearing (H. 25411, Cl. 29485, 28366, 27789, 26809). New to Borneo, previously known from Sumatra and the Peninsula.

Stipe and rachises spiny, sparsely hairy, soon glabrous; lamina much firmer in texture than the two former species, brown when dried. Resembling this species in texture, colour, and cutting is *H. tenuifolia* Copel. Keys: 331 from Pakka (Tp. 1671), the axes however are not spiny but minutely and densely rugose with small raised points, and densely pubescent with short reddish articulated hairs. It may be a distinct species approaching *H. rugulosa* (Lab.) J. Sm. or a high-alpine form of *H. Brooksiae*.

PÆSIA ST. HILAIRE.

P. radula (Bak.) C. Chr.—Below Pakka, open place on ridge (H. 25474, Cl. 27957), Granite dome, sheltered place, 11000 ft. (Cl. 28974), Silau basin, on rock at 7000 ft. (Cl. 29047).

New to Borneo, known previously from Sumatra and recently also found in Celebes (Kjellberg 3576). This has nothing to do with the supposed species of Copeland (Keys 331) which is the same as *Davallia* Baker, transferred by me to *Sphenomeris*, which see.

PTERIDIUM GLEDITSCH.

P. esculentum (Forst.) C. Chr. comb. nov.—*P. aquilinum* subsp. *esculentum* C. Chr. Index.—Dallas, abundant in old clearings (H. 25377, Cl. 28156), Kundasang (Cl. 29107):

This is to me as good a species as most others; it is found in several places in Borneo, which is interesting because it belongs to the southern element which is sparsely represented in the Bornean fern flora, e.g. by *Schizaea fistulosa* and the species of *Blechnum* § *Lomaria*. *P. esculentum* extends northwards to Cambodia. A form of *P. aquilinum* also occurs in Borneo.

DAVALLODES COPELAND.

D. borneense (Hk.) Copel. Keys: 336. 1917. *Dryopteris? borneensis* O. Ktze., C. Chr. Index (with synonymy).—*Davallia nephrodioides* Bak., C. Chr. Index; *Humata nephrodioides* v.A.v.R. Handb. 295; *Leucostegia nephrodioides* Copel. Keys 336; *Davallodes nephrodioides* Copel. Phil. Journ. Sci. 34: 249. 1927.

KINABALU: (Cl. 10322), Kadamaian river, on rocks near Menetendok gorge (H. 25573, Cl. 29562). Sarawak: often collected. Dutch Borneo: W. Kœtai, Long Hut (Endert 2620). New Guinea: Sattelberg (Keysser 17).

The type-specimens of Hooker's *Lastrea borneensis* and Baker's *Davallia nephrodioides* are to me fully identical.

D. Burbidgei C. Chr. n. sp.—*D. hirsuto* Copel. similis, a qua specie differt: Lamina versus basin longe et gradatim attenuata, stipite 2–10 cm. solum longo, indusiis angustis cylindricis, 0.5 mm. longis, ore recte abscisso vix dilatato, parce ciliato vel glabro, lateribus toto connatis. Lamina lanceolata, ad 60 cm. longa, medio 7–14 cm. lata. Indusii formatione *D. grammatosoro* Copel. similis, differt: lamina longe attenuata, characteribus aliis vix a *D. hirsuto* diversa.

KINABALU: Koung (Burbidge, Kew; *Davallia ciliata* Baker 1879: 39; 1894: 251; Hose p. 46), Kadamaian river, on trees (H. 25567). Sarawak: Mt. Bengkarum (Brooks). Dutch Borneo: Liang gagang (Hallier 2774).

This very distinct species was described in MS before Copeland published his monograph of the genus (Phil. Journ. Sci. 34: 242. 1927). He there described a new species from New Guinea, *D. dolichosorum*, which shows the same essential characters as our species, but it is practically glabrous while *D. Burbidgei* is furnished with rather many slender hairs on the ribs beneath.

LEUCOSTEGIA PRESL.

L. hymenophylloides (Bl.) Bedd. (*Davallia* Index, *Araiostegia* Copel. Phil. Journ. Sci. 34: 241. 1927).—Lobang (Cl. 10351, 10388), Tenompok, on trees, frequent and varying much in size (H. 25353, Cl. 28545, 28097, 29230, 27121), Silau basin, rock in river bed at 7000 ft. (Cl. 28446).

This species is the type of Copeland's new genus *Araiostegia*, which should probably be adopted, but I am not sure that all species referred to it by him are congeneric.

L. immersa (Wall.) Pr.—Falls above Lumu, in gorge, epiphyte, at 7000 ft. (Cl. 29982).

HUMATA CAVANILLES.

H. repens (L. fil.) Diels.—*H. intermedia* C. Chr.—below Dallas, on trees by stream (H. 25725), top of Mene-tendok gorge (Cl. 29626), above Dallas (Enriquez 18108).

To this species I refer most forms with the fertile leaves not contracted and as a whole like the sterile ones. Besides the typical form with broadly deltoid, pinnatifid leaves or at best the basal pinnæ free, which also occurs in the Malagassian region, we find in Malaya a number of rather different forms, large and small, *e.g.* *H. intermedia* (*Davallia pinnatifida* Bak.) from Niah, Sarawak (Hose 179, Kew) with the fronds elongate and less broadly deltoid, pinnatifid to the base, the basal segments slightly incised. Another form of *H. repens* is, I think, *H. Brooksii* Copel., Phil. Journ. Sci. 7C: 64. 1912, from Mt. Poi, Sarawak (Brooks 134, Mjöberg), which also is less deltoid but fully pinnate in the lower half, the free pinnæ deeply pinnatifid. Holttum's specimens from Kinabalu are large, rather scaly, and pinnate below, thus approaching *H. Brooksii*. They are almost exactly matched by specimens from the Malay Peninsula. Clemens 29626, from a similar altitude, is much smaller (fronds only 3.5 cm. long). Probably nutrition, exposure and age have much influence on the form of the leaves of this species. There may be local races, but they do not appear to be clearly distinct.

H. alpina (Bl.) Moore?—s.l. (Haviland 1491), Marei Parei ridge (Cl. 11071), near Kamborangah, in low forest (H. 25724), Tenompok (Cl. 26810?).

The specimens quoted would no doubt formerly have been named *H. alpina*, but I am now not at all sure that they belong to that species; I am rather inclined to believe that they are small forms of the following species (*H. kinabaluensis*), from which they differ by being more dimorphous and having much broader sori. Typical *H.*

alpina is a small fern with more or less dimorphous, deltoid bipinnatifid leaves, the fertile segments usually with a tooth protruding beyond the sorus. It seems that Copeland has confounded *H. repens* and *H. alpina*; several specimens named by him *H. repens* should in my opinion be referred to *H. alpina*, and rather typical forms of *repens* he has called *intermedia*.

H. kinabaluensis Copel. 1917: 48.—Pakka (Tp. 1745), near Tenompok on old tree trunk (H. 25295, Cl. 27607), Silau basin 6000–9000 ft. (Cl. 29063).

Near *H. alpina*, and it is possible that the specimens quoted under that species are small forms of this. It is more decidedly dimorphous, the leaves deltoid-elongate, rather densely scaly beneath with red-brown ovate scales, bipinnatifid or bipinnate below, the largest sterile leaf seen 12 by 6 cm., with stipe 7 cm. long; the secondary segments oblong to obovate, 3 mm. wide, entire below the faintly crenate and broadly obtuse apex, decurrent at base; fertile frond contracted with 3 to 6 sori to each secondary segment without protruding teeth. This typical form resembles the Polynesian *H. botrychioides* Brack. more than any other Malayan one. To *H. kinabaluense* I refer with a little doubt some specimens from Pahang: G. Berumban (Henderson 17989) and G. Tahan (H. 20733).

var. **subvestita** C. Chr. n. var.—Much larger than the type, sterile and fertile fronds of the same size (stipe 10–12 cm., lamina 13–17 by 8–10 cm.), the basal pinnæ much the largest, the fertile secondary segments or pinnules serrate with up to 10–12 sori each.

Lobang, on tree in open place (H. 25549). Sarawak: Mt. Murud (Mjöberg).

In size and habit this form resembles more nearly *H. vestita* (Bl.) Moore, to which I have previously referred it, but after a comparison with an authentic specimen of that species at Kew I have arrived at the conclusion that it is a rather large form of *H. kinabaluensis*, with which it agrees in all important characters. *H. vestita* differs in its somewhat more dissected fronds, acute segments, and especially in its much smaller sori, usually with a protruding tooth, thinner texture and dark veins. Intermediate between these large forms is *H. puberula* Copel., Phil. Journ. Sci 7C: 64. 1912, from Mt. Penrissen, Sarawak (Brooks 135, Mjöberg). It is described as hairy, but the "hairs" are evidently a parasitic black fungus which is often found on coriaceous tropical ferns. No species of the genus has true hairs.

DAVALLIA SMITH.

- D. Lorrainii** Hance.—Kundasan, on tree (Cl. 29105).—Dutch Borneo: W. Koetai, Kemoel, (Endert 1925 no. 3604).

These are the first records of the species in Borneo. It has been collected previously in the Peninsula and the Philippines. The specimens from Luzon (Loher 1115, Elmer 6490) and Mindanao (Elmer 10690) were all distributed as *D. bullata*, which resembles *D. Lorrainii* in size and division; the latter species however is very different in its linear densely fringed rhizome scales, in which character it agrees very closely with *D. trichomanoides* Bl. (syn. *D. dissecta* J. Sm., Ind. Fil., under which name it is much cultivated), and the species may be identical.

- D. Lobbiana** Moore.—Tenompok (Cl. 26856, sterile; 26892).—Bettotan near Sandakan (Boden Kloss 19093).

I doubt if this is a good species, and think it to be probably a local form of *D. divaricata*, differing a little in its less decompound fronds (at best tripinnate) and its shorter and broader indusia. Probably *D. Lobbiana* will prove to be identical with *D. decurrens* Hk., but as this is not certain I prefer to use here the former name, originally given to a Bornean plant.

- D. embolostegia** Copel.—Pakka to Lobang (Tp. 1747, 1780), near Tenompok (H. 25415, Cl. 26145, 26856 fertile only, 27120, 27790, 27803), Silau basin at 7000 ft. (Cl. 29051).

The indusia on some fronds are narrow with a long rostrum, on others broader with a short rostrum; it appears that the latter condition is found only in fully mature fronds.

TAPEINIDIUM (Pr.) C. CHR.

- T. pinnatum** (Cav.) C. Chr.—Gurulau spur (Gibbs 3979, t. Gepp. an seq.), Penibukan ridge, frequent in forest on ridge top (H. 25603).
- T. biserratum** (Bl.) v.A.v.R. Handb. Suppl. 509. 1917.—*Davallia biserrata et gracilis* Bl.—*D. luzonica* Hook.—*D. Hosei* Baker Journ. of Bot. 1888: 323; *Leucostegia Hosei* Copel. Keys 336.—*Davallia oligophlebia* Baker l.c., *Tapeinidium oligophlebium* C. Chr. Index.—Gurulau spur (Tp. 1621, 1826), Lobang, on steep rocky slope in forest (H. 25546), Bungal (Cl. 27839), Tenompok (Cl. 28350).

An extremely variable species, referred by almost all writers to *T. pinnatum* as a variety. All its forms differ however in several important characters from typical

pinnatum, e.g., the dark green deltoid leaves and more or less incised pinnæ, the basal ones often very much prolonged. *T. oligophlebium* is, I think, only a dwarfed form.

SPHENOMERIS MAXON,

Journ. Wash. Acad. Sci. 3: 144. 1913.

S. chinensis (L.) Maxon l.c.—*Odontosoria* Index, Copel, Keys 343.—Koung (Burbidge), Kaningau plain (Gibbs 2976), Kiau (Tp. 1506), Ridge above Bungal (Cl. 29161), Dallas (H. s.n.).

Exceedingly abundant on the steep banks beside the bridle paths.

S. Veitchii (Bak.) C. Chr. comb. nov. *Davallia Veitchii* Baker 1879: 39; Copel. Keys 340.—*Paesia*? sp. Copel. Keys 331.—s.l. (Burbidge), Marei Parei spur (Tp. 1876).

A remarkable fern, mostly resembling a finely cut *S. chinensis*, with a similar creeping rhizome clothed with cylindrical castaneous, septate hairs. Stipe up to 35 cm., glossy, glabrous as the whole leaf, lamina coriaceous, lanceolate or deltoid-oblong, 30–40 cm. long, 4-pinnate, the largest pinnæ 10 cm. long, deltoid, ultimate segments under 1 mm. wide, thick, often cleft at the apex, with a single vein. Sori one to each segment, very like those of *Trichomanes*, campanulate or turbinate, immersed and free at the mouth only, about 1 mm. long.

SCHIZOLOMA GAUDICHAUD.

S. Jamesonioides (Bak.) Copel.—s.l. (Burbidge, type), Marei Parei ridge (Haviland 1495, Gibbs 4061, Cl. 10909, 11063, H. 25607). In rock crevices in a fully exposed place on the open ridge, the young fronds bright red.

S. induratum (Bak.) C. Chr. is said to have been collected on Kinabalu by Haviland (Hose, p. 49), but as it is not in Stapf's list the record is doubtful.

LINDSAYA DRYANDER.

Most species of this difficult genus found on Kinabalu were dealt with by Holttum in his paper: The genus *Lindsaya* in the Malay Peninsula, Gard. Bull. S.S. 5: 58–71. 1930, to which I refer in the following. The identification of some species is due to Holttum.

L. plumula Ridl. Journ. Mal. Br. R. Asiatic Soc. 4: 22. 1926.—Tenompok Silau creek, on rocks in stream (Cl. 28603).

This matches very closely the type of the species, which was found on G. Tahan in the Malay Peninsula at about the same altitude and growing under exactly similar conditions.

L. concinna J. Sm., Hook. Spec. Fil. 1: 205 pl. 61B.—*L. gracilis* p.p. C. Chr. Index.—Koung to Kiau (Tp. 1504, Cl. 9891).

L. scandens Hook., Holttum l.c. 62 (incl. *L. lancea* auctt. as to Malayan plants, Copel. Keys 342).—*L. pectinata* Baker 1879: 40.—s.l. (Burbidge), Marei Parei ridge (Tp. 1871).

I agree in considering the Malayan *L. lancea* to be a bipinnate form of *L. scandens*, although that keen pteridologist, the late Prof. Hieronymus, in his last paper (Hedwigia 62: 14. 1920) segregated it from the true American *L. lancea* as a distinct species, *L. parasitica* Wall.

L. pectinata Bl., Holttum l.c. 62.—Gurulau spur (Gibbs 4001, doubtful), Tenompok-Lumu Lumu (H. 25435), Marei Parei ridge (H. 25608), Tenompok (Cl. 28597).

The earliest leaves of this species, so far as I was able to see, always resemble the later ones in form (thought not in size); they are not finely dissected as are those of *L. repens*.

L. repens (Bory?) Bedd., Holttum l.c. 63.—Lobang to Kiau (Tp. 1807), Gurulau spur (Tp. 1841), near Dallas, on rocks by stream and on trees (H. 25145), Tenompok (Cl. 28266, 27189, 29507, 26651), Lumu Lumu to Kamborangah (Cl. 28002).

I fear that the specific name usually given to this common Malayan species must be changed, because the original *Dicksonia repens* Bory from Réunion is no doubt quite another species, near *L. cultrata*. The rhizomes of the Malayan plants produce finely dissected bathyphylls, which look different in different specimens, indicating perhaps that "*L. repens*" is really an aggregate.

L. tenera Dryander, Holttum l.c. 64.—*L. orbiculata* var. C. Chr. Index.—*L. gomphophylla* Bak. (t. sp. orig. Kew).—Near Dallas, in forest (H. 25149, 26895).

L. borneensis Hook., Holttum l.c. 65.—Marei Parei ridge (Tp. 1851).

L. diplosora v.A.v.R. Bull. Jard. bot. Buit. II Ser. no. XVI: 21. 1914.—Lumu Lumu to Kamborangah, on bases of trees in open mossy forest on ridge (H. 25459, Cl. 27061, 28001, 28963). New to Borneo. Described from Sumatra: G. Singgalang (Matthew 523!).

var. **acrosora** C. Chr. n. var.—Larger than the typical form of the species (pinnæ to 25 cm. long), herbaceous, and the narrower pinnules constantly monosorous.

Marei Parei ridge (Cl. 11045).—Sarawak: Mt. Tibang, 1400–1700 m. (Mjöberg, type, in Herb. C. Chr.). Dutch Borneo: W. Kutai, Kemul (Endert 4367).

L. diplosora belongs to a small group of bipinnate, Malayan species with free or occasionally anastomosing veins, wide-creeping, cylindrical, brown and glossy, asperulous rhizome, and terete stipes. The oldest known species is *L. rigida* J. Sm. from the Peninsula, which is marked by coriaceous leaves with much thickened margins and prominent veins; the pinnules are usually monosorous with a single sorus at the tip, but sometimes with two or three sori. Such a form is *L. triplosora* v.A.v.R., l.c., from G. Sago, Sumatra (Matthew 686!) and W. Kutai, Kemul, Borneo (Endert 4267), which is less coriaceous with the veins hardly raised, but otherwise like *L. rigida*, and in my opinion not specifically different. Very near, perhaps too near, *L. rigida* is *L. monosora* Copel. in Elmer's Leaflets 2: 398. 1908, from Negros; *L. monosora* Rosenst. Nova Guinea 8: 720 (syn. *L. monocarpa* C. Chr. Index Suppl. 49. 1913) is identical, and has recently been found also in Celebes (Kjellberg 3571). *L. monosora* differs from *L. rigida* chiefly in its much narrower and less coriaceous pinnules which are constantly monosorous; their margins are distinctly thickened, and I am inclined to think this a shade-form of *L. rigida*.

From all these *L. diplosora*, with its variety, differs by its more ascending pinnæ and especially by the *thin* margins and rather thin texture. H. 25459 is exactly like the type, the broadly truncate pinnules with two sori (or occasionally only one). Var. *acrosora* is different in the characters mentioned above. The veins of both forms are free, by which character the variety differs from *L. longissima* Christ, a species of the same group with pinnæ up to 60 cm. long.

Whether all these forms are really specifically different must be decided by studies in the field. It seems probable to me that the differences between them may be due to different habitat conditions.

L. decomposita Willd., Holttum l.c. 66.—Marei Parei spur (Gibbs 3079?), Lobang (Cl. 10362), Kamborangah, in valley forest (H. 25729).

This species is here taken in its wide sense. The two specimens seen are not quite identical, but they cannot properly be referred to any species described by Holttum. No. 25729 is near the type as I understand it, having narrow indusia which are rather remote from the edge of the lobe.

L. recurvata Wall., Holttum l.c. 66.—below Dallas, on shady bank by stream (H. 25132, Cl. 27267), Dallas-Tenom-pok ridge (Cl. 27744?). The smaller fronds have quite

entire and obtuse pinnæ; the basal pinnæ of the larger fronds are lobed into 4 or 5 segments. Cl. 27744 may be distinct species; it has the decurved pinnæ not more than 1 cm. long.

- L. nitida** Copel. Phil. Journ. Sci. 6C: 138, pl. 21. 1911.—Marei Parei spur (Tp. 1866), Penibukan ridge (H. 25602).

The simply pinnate form of this species, I think; in Sarawak pinnate and bipinnate fronds seem to be equally frequent. I am inclined to believe that it is not specifically different from *L. nitens* and that *L. integra* Holttum l.c. 67 may be a form of the same. *L. nitida* differs from *L. integra* by its not ascending pinnæ; from *L. recurvata* by its smaller pinnæ (14 by 6 mm.); and from both by its shining upper surface.

- L. kinabaluensis** Holttum sp. nov.—Rhizomate breve repente, stipitibus approximatis, 4-angulatis, stramineis vel subcastaneis. Frondibus plantarum juvenilium pinnatis, stipitibus 6 cm. longis; frondibus plantarum adultarum bipinnatis, stipitibus ad 20 cm. longis. Lamina frondium pinnatarum ad 14 cm. longa 2 cm. lata; pinnis c. 25-jugis, infimis maximis, recurvatis, margine superiore lobatis, ceteris integris, superioribus apicem versus sensim reductis, medialibus triangulatis, margine inferiore curvata adscendente, margine superiore fere horizontale, ad 10 mm. longis, basi ad 5 mm. latis, apice anguste rotundatis; venis reticulatis, areolis 2-seriatis, areolis inferioribus c. 6; soris continuis marginem superiorem totam occupantibus (pinnis inferioribus lobatis exceptis); indusiis angustis crispatis. Pinnis frondium bipinnatarum 1-3-jugis, maximis 9 cm. longis 1 cm. latis, pinnulis 25-30-jugis, superioribus sensim reductis, ceteris subtriangularis vel trapezoideis, maximis 5 mm. longis, basi 4 mm. latis, margine inferiore leviter adscendente, margine superiore fere horizontale apicem versus decurvata, apice anguste vel late rotundata vel subtruncata; venis paucis, anastomosantibus vel liberis (soris exceptis); rhachi 4-angulato, supra canaliculato.

KINABALU: Dallas (Cl. 27744, simply pinnate stage), Tenompok (H. 25433, bipinnate fronds).

A member of the group of *L. decomposita*, with very small pinnules. Though the collections of juvenile and adult fronds were made separately, there is little doubt that they represent the same species. The simply pinnate fronds are fully fertile. The same condition is found in *L. recurvata* and other species; always the pinnules on the bipinnate fronds are smaller than the pinnæ of the juvenile simply

pinnate fronds, the veins fewer, and anastomosis consequently less. If it should happen that I am wrong in regarding the two collections here cited as being forms of the same species, the bipinnate specimen should constitute the type of *L. kinabaluensis*. (R.E.H.).

L. davallioides Bl.—Tenompok, near stream in forest (H. 25403, Cl. 28215). Smaller leaves simply pinnate, larger tripartite.

L. parallelogramma v.A.v.R. Bull. Jard. bot. Buit. III Ser. 5: 212. 1922. Holttum l.c. 70.—Dahobang river, in forest above river (H. 25597).

Though closely allied to *L. davallioides*, I believe this species is distinct. It has quite a different aspect in the field, and in specimens seen by me the degree of dissection and the venation are reasonably constant. (R.E.H.).

L. crispa Baker 1879: 39; Ic. Plant. 1627.—*L. impressa* Chr.—s.l. (Burbidge, type), Tenompok, in forest (H. 25420, Cl. 28645), near Lobang. (H. 25728?).—Sarawak: Mt. Dulit (Mjöberg). Dutch Borneo: Amai Ambit (Hallier 3137).

This very distinct species was described and illustrated by Baker from incomplete specimens consisting mainly of short pinnate leaves; there is also however a fragment of a frond on a stipe 22 cm. long, not mentioned by Baker, which proves that *L. impressa* Chr. is the same species. As neither Baker's nor Christ's description is adequate I give a new one from Holttum's complete specimen.

The short creeping rhizome bears a rosette of simply pinnate leaves, up to 25 cm. long by 3 to 3.5 cm. wide, the stipe 5–6 cm. long, quadrangular, brownish (or stramineous); pinnæ numerous, close, alternate, sessile, dimidiate, subrectangular, the largest 2.5 to 2.7 cm. long, 4 mm. wide, the lower edge straight or decurved, the inner truncate, the upper irregularly dentate, the apex subtruncate, dentate, texture thinly herbaceous, veins somewhat raised above, impressed beneath making the pinnæ wrinkled, anastomosing and forming a row of oblique areoles above the much thickened costuliform lower margin; in smaller leaves the veins are free or only occasionally united. These smaller leaves are sometimes fertile with short sori at the tips of the teeth (not in Holttum's specimen). Among these leaves one or two normal fertile ones are raised on reddish-brown *terete* stipes up to 30 cm. long, the lamina bipinnate with 1–2 pairs of lateral ascending pinnæ, 10 cm. long, the terminal pinna 15 cm. long by 2.5 cm. wide, lanceolate, acuminate, rachis reddish, quadrangular, with all 4 angles raised and sharp; the pinnules dimidiate, triangular, 1.5 cm. long, 4–5 mm. wide at the truncate base, gradually narrowed from the base to the acute point, the lower edge

straight, the upper entire, the veins united as in the smaller leaves but not rarely free, not nearly so impressed (or not at all) as in the sterile fronds, the pinnules, therefore, not folded into wrinkles; all pinnules fertile with one continuous (rarely interrupted) marginal sorus along the upper edge, which like the indusium is undulate.

L. crispa is a unique species of doubtful relationship; I do not know any species resembling it. It is known from Borneo only.

TÆNITIS WILLDENOW.

T. blechnoides (Willd.) Sw.—Dallas (Cl. 27218), Penibukan ridge (H., s.n.).

OLEANDRA CAVANILLES.

O. oblanceolata Copeland, Phil. Journ. Sci. 7C: 64. 1912.—Marei Parei spur (Cl. 11053), near Lumu Lumu, in ridge forest (H. 25723), above Lumu, on fallen tree (Cl. 27210), Tenompok (Cl. 28763), Dallas-Tenompok ridge (Cl. 28337).

Very doubtfully different from *O. colubrina* (Blanco) Copel. I have seen some Bornean specimens which are intermediate between the two species recognised by Copeland.

NEPHROLEPIS SCHOTT.

N. radicans (Burm.) Kuhn.—Dallas, East ravine (Cl. 27297, sterile).

N. acuminata (Houtt.) Kuhn.—Gurulau spur (Cl. 10774), Dallas (Cl. 26925), Tenompok (Cl. 28065).

N. hirsutula (Forst.) Pr.—Kundasang (Cl. 29241).

N. barbata Copel.—Menetendok gorge (Cl. 29548).

This matches perfectly Copeland's type from Mindanao. It is a new record for Borneo. The species also occurs in the Malay Peninsula, having been reported previously as *N. exaltata*. It always grows on rocks and trees, with often very long pendulous fronds, rather pale green in colour.

ARTHROPTERIS J. SMITH.

A. obliterated (R. Br.) J. Sm.—Dallas-Tenompok trail, climbing tree (Cl. 27383), Tenompok (Cl. 29568).

CYSTODIUM J. SMITH.

C. sorbifolium (Sm.) J. Sm.—*Saccoloma* C. Chr. Index.—Kabayau to Koung in forest by stream (Tp. 1501, H. 25106, Cl. 27677).

DRYOPTERIS ADANSON.

The species of this large genus are arranged below according to the classification in my monograph of the genus,* in which the American species only are dealt with. It appears, however, that most species of the Old World naturally fall under the subgenera there defined, but it seems to me more natural to unite as a special section or subgenus, *Abacopteris*, certain species (chiefly Malayan) which would fall into the subgenus *Cyclosorus*, if this were taken in a wide sense. *Abacopteris* may be said to represent in Asia the American subgenus *Goniopteris*.

SUBGENUS LASTREA (Bory) EMEND. C. CHR.

D. gracilescens (Bl.) O. Ktze.—Tenompok, in forest, rhizome short-creeping (H. 25384), Lumu trail, 6000 ft. (Cl., s.n.).

Differs a little from the Javanese type in its long stipe (up to 35 cm.); otherwise typical. All veins are simple, and it differs thereby from *D. Creaghii* (Bak.) C. Chr. from British North Borneo (Kew!), which is very similar to, and in my opinion the same as, *D. Dayi* (Bedd.) C. Chr. from the Peninsula, which again is very doubtfully different from the Sumatran *D. singalanensis* (Bak.) C. Chr. (syn. *D. aureo-viridis* Rosenst. in Fedde Repert. 13: 216. 1914).

D. viscosa (J. Sm.) O. Ktze.—*Nephrodium gymnopodium* Bak. 1894: 252; *Dryopteris* C. Chr., Copel Keys 358.—*D. kinabaluensis* Copel. 1917: 57.—*D. Ridleyi* (Bedd.) C. Chr.—s.l. (Haviland 1486, type of *D. gymnopoda*), Marei Parei ridge (Cl. 11086), Pakka, in open forest on ridge (Tp. 1719, type of *D. kinabaluensis*; H. 25512, Cl. 27971, 29333), Kamborangah (Cl. 28964), Dachang at 10000 ft. (Cl. 29066).

I have tried in vain to distinguish from *D. viscosa* the species quoted as synonyms. *D. viscosa* is widely distributed in the Malayan region and fairly constant as to its most prominent characters: its erect, often much elongated rhizome, dark stipe, dark brown or nearly black colour of the dried frond, and drooping basal pinnæ, by which characters it differs from *D. gracilescens*. The under surface of younger fronds is dotted with brown, gum-like glands which dry out with age and are therefore lacking in old or poisoned fronds.

var. **kamborangana** C. Chr. n. var.—Larger than the type, stipe and rachis grey-brown, the lowest 3 or 4 pairs of pinnæ deflexed, not reduced, to 12 cm. long with

* Vid. Selsk. Skritter VII. 10, 1912 (Part 1) and VIII. 6, 1920 (Part 2).

sometimes deeply serrate segments, both surfaces finely glandular, indusia large, brown, reniform.

Lumu Lumu to Kamborangah, in rather open places in forest (H. 25472), Marei Parei ridge, in shady forest (H. 25609).

This variety looks rather different from the other Kinabalu forms of *D. viscosa*, but it is scarcely a distinct species.

D. badia v.A.v.R. Bull. Jard. bot. Buit. II ser. no. XVI: 9. 1914.—*D. linearis* Copel. 1917: 56.—Marei Parei ridge (Cl. 11067, 11069), Lumu Lumu to Kamborangah (H., s.n.).

The type of *D. linearis* is perfectly identical with a co-type specimen of *D. badia* from Sumatra received from Dr. Matthew. It is closely related to *D. viscosa*, of the same dark colour and with the same pubescence of short brown, crisped hairs on the rachis and costæ above, differing chiefly by the elongated linear-lanceolate fronds with short, somewhat unequal-sided pinnæ. It resembles in habit some forms of *Athyrium macrocarpum*.

D. multisora C. Chr. n. sp.—Speciei præcedente proxime affinis, differt: majore, pinnis æquilatis, linearibus, rachi costisque pilis pallidis, tenuissimis superne hirtis, soris confluentibus, indusiis orbicularibus, peltatis, glandulosis.

KINABALU: Kamborangah, in valley forest (H. 25523, type, in Herb. C. Chr.), Tenompok, in forest (H. 25417, Cl. 28098, 28340), above Pakka (Cl. 27970).

Rhizome stout, erect, the stipe strong, castaneous, furnished with numerous pure-brown thin scales, up to 45 cm. long; lamina linear-lanceolate, 50 by 15 cm., rather thick dark-coloured, bipinnatifid, rachis with some few scales and pubescent above with slender grey hairs. Pinnæ sessile, the lower ones opposite, at distances of 3.5 cm., the basal ones not reduced, not deflexed, 8 cm. long by 1.5 cm. wide, linear-oblong, equal-sided, acuminate, deeply pinnatifid, the segments patent, separated by open, roundish sinuses, oblong, 2.5 mm. wide, entire, the apex roundish-obtuse. Costæ densely strigose above with grey antrorse hairs (some few similar hairs also on the costules and veins above), thinly short-puberulous beneath, the surfaces otherwise glabrous and without glands. Veins simple, about 6-jugate, all fertile. Sori large, at last confluent and filling the whole underside of the segment; indusia brown, orbicular, peltate (at least in no. 25417), glandular; sporangia large, glabrous.

D. supravillosa C. Chr. n.sp.—*D. viscosae* affinis, differt: stipite rachique paleaceis et dense villosis, lamina

superne densissime villosa, inferne ad costulas venasque solum pubescente.

Lumu Lumu to Kamborangah, in mossy ridge forest (H. 25471, type in Herb. C. Chr.).

Rhizome erect, with many ovate brown scales. Stipe light brown, 12–15 cm. long, rather scaly with brown small lanceolate somewhat lacerated scales, and upwards villous with soft pale hairs, rough towards base (from the bases of fallen scales). Lamina lanceolate, about 20 cm. long by 8 cm. wide, firmly herbaceous, olive-brown when dried, bipinnatifid; rachis densely villous and with some few small scales on the lower part, the hairs partly very short, thin, and crisped, partly long, patent, and rather stiff. Pinnæ 10–15 pairs, alternate, sessile, 5–6 cm. long by 1.3 cm. wide, equal-sided, short-acuminate, the basal ones deflexed and somewhat reduced, segments 12 to 13 pairs, oblique, 3 mm. wide, repand-crenate or faintly dentate, the apex truncate or retuse, the upper side wholly covered with short pale hairs, the costa and midribs only pubescent beneath, the under side glandular. Veins 4–5–jugate, simple. Sori medical; indusia reniform, large, brown, glandular.

This species differs from *D. Robinsoni* (Ridl.) C. Chr. Gard. Bull. S.S. 4: 381. 1929 in having pinnæ twice as wide, lobes much wider, greater hairiness and lack of glands on the upper surface.

D. inconspicua Copel. 1917: 55.—Kiau (Tp. 1543), Gurulau spur (Tp. 1837, 1839), Dallas-Tenompok ridge (Cl. 27603, 27325, 27432, 26893), Tenompok (Cl. 28099).—Dutch Borneo: W. Kutai, Kemul (Endert 3960).

Superficially resembling *D. gracilescens* and forms of *D. viscosa*, but in reality very different, not only by the extremely reduced lower pinnæ (2–3 mm. long only), but also by the anterior basal vein running to the sinus.

GROUP OF *D. CRASSIFOLIA* (C. Chr. in Gard. Bull. S.S. 4: 381. 1929).

D. crassifolia (Bl.) O. Ktze., C. Chr. l.c. 385.—Tenompok to Lumu Lumu in ridge forest, not very abundant (H. 25440), near Dallas (H. 25254, Cl. 27526).

var. **purpureo-lilacina** C. Chr. n. var.—Sporangia superficiali totam tegentibus, pulchre purpureo-lilacinis. Penibukan ridge (H. 25599).

I have never seen a fern with the sporangia coloured like this. The sterile leaf does not differ from typical *D. crassifolia*, the rachis of the fertile one is more scaly and the segments are more falcate.

GROUP OF *D. SYRMATICA* (PTERIDRYS C. Chr.).

An Asiatic group of closely related species which should no doubt be segregated from *Dryopteris*, being totally different from all species of this genus in all characters except in sori; *e.g.*, in colour, texture, pubescence, division, venation etc. In habit some of them resemble species of *Pteris*, of the group of *P. quadriaurita*.

- D. microthecia** (Fée) C. Chr. Index Suppl. 1913-16: 15. 1917.—*Aspidium microthecium* Fée, 10e mém.: 37, t.41 f.2A. 1865.—*Dryopteris Metteniana* Hieron., Christ, C. Chr. Index Suppl. 35. 1913.—*D. subsa-genoides* v.A.v.R. Bull. Jard. bot. Buitenz. II Ser. XI: 9. 1913.—*D. Vangenderenstortii* v.A.v.R. l.c. no. XVIII: 11. 1916.—near Dallas (H. 25261, Cl. 27384), near Menetendok, river bank (H. 25584).

Found in several places in Borneo and other Malayan islands. It is very near the genuine *D. syrmatica* (Willd.) O. Ktze, but tolerably distinct in its sessile or only short-stalked pinnæ, the basal ones with one or two prolonged pinnules on the lower side, and by the sori being apical on the veins.

GROUP OF *D. SETIGERA*.

- D. setigera** (Bl.) O. Ktze.—below Dallas, open place in old clearing (H. 25369), Kundasang, secondary growth (Cl. 29242), Tenompok (Cl. 29497A).
- D. multiseta** (Bak.) C. Chr.—Dallas to Tenompok, by path on edge of forest (H. 25294).—Sarawak: Mt. Matang (Hose 98, Hewitt).

This species is also known from Sumatra (Sibolangit, Lörzing 5779). It should be compared with the actual type of *D. setigera*.

On Kinabalu I only saw this species once. More recently I have seen it growing abundantly by roadsides in Sumatra at about 2000 feet or more above sea level. It may reach a very large size, with stipes a metre long and fronds of the same length. The stipes of old plants are often reddish. It is a very handsome fern, and very distinct from the much smaller *D. setigera*; both are ferns of rather open places, not of the shady forest. *D. multiseta* is now growing well in cultivation in Singapore, and it is surprising that it has not been found growing wild in the Peninsula.

GROUP OF *D. IMMERSA*.

- D. immersa** (Bl.) O. Ktze.—Kundasan, edge of jungle (Cl. 29765), Dallas-Tenompok ridge, by path (Cl. 27739, 27523), Tenompok (Cl. 26834).

This species was common beside the bridle path, but I saw no fertile plants during my visit.

SUBGENUS CYCLOSORUS (Link) emend. C. CHR.

- D. contigua** Rosenst. Meded. Rijks Herb. Leiden no. 31: 8. 1917.—Koung to Lobang (Tp. 1900), Kabayau to Koung (Cl. 27692), in low altitude without locality (H. 25727), Kundasang (Cl. 29238), Dallas (Cl. 27739, 27475).—Sandakan (Elmer 20383).—Sarawak: Mt. pok Cl. 28233), Silau basin at 6000 ft. on rocks (Cl. Poi (Mjöberg).

Very briefly described from a specimen from Borneo, coll. Teuscher. It falls under *D. parasitica* sens lat., but is no doubt quite different from the typical form of that species, though resembling it in pubescence and venation, differing chiefly by its long narrow lamina on a very long stipe and by the lower 2 or 3 pairs of pinnæ being more or less abbreviated. The rhizome is short, erect. In the narrower pinnæ (about 1 cm. wide) the basal veins are not always united, but connivent to the sinus.

- D. parasitica** (L.) O. Ktze.—*Aspidium tectum* Wall.—s.l. (Tp. 1513), near Menetendok, by river side (H. 25574), Tenompok bridle path (Cl. 27469).—Rhizome creeping.
- D. subpubescens** (Bl.) C. Chr. Gard. Bull. S.S. 4: 390. 1929.—Koung (H. 25121), near Menetendok, in open forest near stream (H. 25575, glabrous form).
- D. heterocarpa** (Bl.) O. Ktze.—Lobang (Tp. 1788), Tenom-29054, 29050), Marei Parei (H. 25600?).

H. 25600 is an aberrant specimen with unusually long spreading hairs on costæ on veins beneath.

- D. porphyricola** Copel. Phil. Journ. Sci. 7C: 60. 1912.—Tenompok (H. 25389, Cl. 27190, 27371, 28282, 28456).

A species similar to *D. stipellata* (Bl.) in size, division, the presence of large ærophores, and in the antrorsely strigose ribs of both surfaces, but differing in the upper surface being densely strigose throughout with antrorse, adpressed grey hairs, and in the under surface being densely glandular with globose yellow glands. In the last-named character it agrees with *D. heterocarpa*, but *D. heterocarpa* is smaller, has the hairs beneath crisped-patent and lacks the large ærophores. *D. porphyricola* is known from Sarawak (Bau, Brooks 12; Mt. Merinjak, Native Coll. 180), and I have referred to it with some doubt Elmer 22075 from Mt. Pinatubo, Luzon. The Kinabalu specimens differ a little from the type in the abortive pinnæ being extremely small. Gibbs 4035, referred by Gepp to *D. stipellata*, may belong here.

H. 25389 when fresh had the young fronds covered with mucilage (through which the ærophores projected) like those of *D. stipellata*; this character is not reported for the other specimens, but their ærophores are conspicuous. In the Peninsula, *D. heterocarpa* is very variable in the extent of hairiness of the upper surface and of the costæ beneath, and there may be similar variation in *D. porphyricola*. The study of further material may indicate that *D. porphyricola* should be regarded as a variety of *D. stipellata*. (R.E.H.).

D. lobangensis C. Chr. n. sp.—Rhizomate repente, sparse paleaceo. Stipitibus remotis, ad 40 cm. longis, glabris, nitidis, parte dimidia superiore auriculis pluribus minimis instructis. Lamina late lanceolata, 25 cm. longa, medio 10–13 cm. lata, chartacea, bipinnatifida, apice pinnatifida, basi subito in auriculas contracta, rachi superne dense antrorsim strigosa, inferne angulari, glabra. Pinnis sessilibus, alternis, apice integro breve acuminatis, inferioribus 2–3-jugis deflexis, 2–3 cm. inter se remotis, 5 cm. longis, 12 mm. latis, paulo supra medium pinnatifidis, segmentis densis, obliquis, obtusis vel subacutis, basi 3 mm. latis, basalibus vix acutis, costis ut rachi superne strigosis, inferne glabris sed cum venis glandulis luteis sat dense glandulosis, marginibus sparse ciliatis. Venis simplicibus, 5-jugis, basalibus unitis, secundi paris ad sinum conniventibus. Soris medialibus, indusiis parvis, cito delapsis, sporangiis glabris.

KINABALU: Lobang (Cl. 10728, type in Herb. Copeland).

Differs from *D. heterocarpa* and related species by the chartaceous texture, deflexed lower pinnæ, the less deeply cut pinnæ with oblique segments, and by the glabrous but glandular under side.

D. arida (Don.) O. Ktze.—Kiau (Tp. 1560).

D. callosa (Bl.) C. Chr.—Lobang (Cl. 10347).—Typical, new to Borneo.

D. lithophylla Copel. 1917: 57.—Marei Parei ridge, exposed place (Tp. 1850, H. 25601).

An extremely coriaceous plant with ærophores along the stipe to the base, the young fronds covered with mucilage.

D. unita (L.) O. Ktze.—Near Dallas, wet grassy places by path, abundant (H. 25263, Cl. 26928), Kundasang, edge of secondary growth (Cl. 29240).

D. oosora (Bak.) C. Chr.—Kudat, by stream (H. 25102).

This is technically a *Mesochlaena* because of its oblong indusia, but as to all other characters it so closely resembles *D. unita* that it seems unnatural to segregate it from

Dryopteris. It further differs from *D. unita* by its thinner texture, broader segments and two pairs of united veins, short-creeping rhizome, the stipe with 2-4 pairs of small auricles below the lowest developed pinnæ, the pinnæ 20 cm. long by 2 cm. wide, incised half-way, the whole frond rather densely but shortly grey-pubescent. The species was known previously from Pulo Gaya, B.N. Borneo, only (Hose 334).

D. megaphylla (Mett.) C. Chr.—Kiau (Tp. 1531), Dallas (Cl. 27288, 26766, 27317). A form with narrow pinnæ, approaching *D. arbuscula* (W.) O.K.

D. truncata (Poir.?) O. Ktze.—Kiau (Cl. 10233), near Dallas, frequent in forest (H. 25260, Cl. 27541), Tenompok (Cl. 28646, 29450).

D. Toppingii Copel. 1917: 56. C. Chr., Gard. Bull. S.S. 4: 391.—Lobang (Tp. 1766), Tenompok (H. 25395, Cl. 28082), Dallas-Tenompok ridge Cl. 27543, 27729).

A species of doubtful relationship. In colour, texture, cutting and lack of auriculiform pinnæ it resembles *D. crassifolia* rather than the foregoing species, but it agrees with them in venation, about 4 pairs of veins being united.

D. ferox (Bl.) O. Ktze.—Silau basin, among rocks in jungle, at 7000 ft. (Cl. 29062).

D. baramensis C. Chr. n. sp.—*Cyclosorus*? Rhizomate breve suberecto. Stipite ad 35 cm. longo, brunneo, minutissime puberulo, ad basin solum parce paleaceo, ærophoris tuberculiformibus, 5-6-jugis, remotis (pinnis abortivis) instructis. Lamina ovato-lanceolata, ad 50 cm. longa, 20-40 cm. lata, chartacea, sicca brunnea, bipinnatifida, rachi subpuberula, mox glabra. Pinnis ca. 15-jugis, oppositis, 3-4 cm. inter se remotis, breve petiolulatis, maximis 25 cm. longis, 4 cm. latis, infimis evolutis vix reductis, subito in apicem acuminatum, subintegrum contractis, ad alam 3 mm. latam pinnatifidis. Segmentis obliquis, lateribus parallelis integerrimis, apice postice rotundatis antice subacutis, 3-4 mm. latis, basalibus pinnarum inferiorum multo abbreviatis, superiorum æqualibus; pagina superiore pilis griseis appressis ubique sat dense strigosa, inferiore ad costas venasque antrorsim strigosa, inter venas minutissime glandulosa. Venis simplicibus, ca 10-jugis, infimi paris unitis. Soris supramedialibus, sæpe uno in vena basali anteriore et 3-5-jugis in venis superioribus; indusiis persistentibus, reniformibus, puberulis.

SARAWAK: Baram valley, Lio Matu, 3-4000 ft. alt., common in a thick forest (Mjöberg, 1923, type in herb. C. Chr.). Kinabalu: Tenompok, frequent in forest (H. 25385, Cl. 27938, 26932, 30456, 27601, 28453 part).

Nearly related to *D. porphyricola* Copel, but the lower pinnæ reduced to tuberculiform glands (ærophores), pinnæ much deeper cut, with only one pair of united veins, the lower ones narrowed towards their base. Both species belong to a small group of Malayan species, the natural position of which is still uncertain to me. In colour and texture they are quite different from the bipinnatifid species of *Cyclosorus*, resembling more nearly *D. crassifolia* and its relatives, but the venation and presence of abortive pinnæ show that they cannot properly be associated with *D. crassifolia*. The specimens from Kinabalu are on the whole typical, but differ in usually having a glabrous upper surface and no glands beneath; they probably represent a local variety. Some specimens have hairs on the upper surface towards the costæ, the segments being glabrous.

SECTION ABACOPTERIS (Fée).

Under this name I provisionally unite a considerable number of Malayan species which seem to be quite different from the bipinnatifid species of the subgenus *Cyclosorus*, so different that they might naturally be segregated from it to form a new subgenus. The species concerned are certainly very different from each other in some important characters, but very uniform in others, especially colour, texture, pubescence, and the fronds at best simply pinnate. The fronds are quite entire in a few species, but in most they are pinnate with entire or slightly lobed pinnæ with many pairs of often alternately united veins, their under side often characteristically verrucose. The species may be divided into groups, which however run into one another. A long series of small, closely related species are marked by dimorphous fronds, the fertile ones being much contracted with confluent sori (*Haplodictyum* Presl, type *D. acrostichoides* (J. Sm.) v.A.v.R.); this group runs gradually through several intermediate forms into the next (*Abacopteris* Fée, type *D. lineata* (Bl.) C. Chr.), to which I refer larger species with conform fronds, which may be simple, or pinnate with few pairs of pinnæ; from these species we come gradually to the big ones, such as *D. urophylla* (Wall.) C. Chr., which form a third group, in which I include the Asiatic species of *Meniscium*. *Stegogramma* Bl. is an offshoot of the last group.

To this "subgenus" belong several Bornean species, some of which were originally described as species of *Acrostichum* by Baker, and were transferred in my Index to *Leptochilus* (*L. exsculptus*, *L. oligodictyus*). From Kinabalu the following species have been collected.

D. Hosei (Bak.) C. Chr.—Kabayau to Koung, rocky stream margin (Cl. 27663).

D. exsculpta (Bak.) C. Chr. in Copel. Phil. Journ. Sci. 37: 310. 1928. *Leptochilus* C. Chr. Index.—*Dryopteris brevipinna* C. Chr. Index (*Meniscium stenophyllum* Bak.)—Penibukan ridge (H., s.n.). Other collections at Singapore are: Bettotan, near Sandakan (Kloss 19036). Sarawak: s.l. (Hose 20, 244).

The Kinabalu collection differs somewhat from the Sandakan plant, having more coriaceous and less strongly toothed pinnæ. The pinnæ are however distinctly toothed, and in shape and size agree with *D. exsculpta* rather than with *D. tenompokensis* (see below); they also agree with Kloss's specimen in having strongly setose indusia and sporangia. (R.E.H.).

D. tenompokensis C. Chr. n. sp.—Foliis dimorphis *D. exsculptae* (Bak.) C. Chr. et *D. Hosei* (Bak.) C. Chr. similis, differt a priori: pinnis integerrimis; a posteriore: pinnis basi truncatis vel subcordatis, rachin subamplectentibus.

KINABALU: Tenompok, on rocks by stream in forest (H. 25388, type in Herb. C. Chr., Cl. 27622).

Rhizome short-creeping, the leaves subfasciculated, dimorphous. Sterile fronds to about 50 cm. long (including the stipe 20 cm.), 10–17 cm. wide, the pinnæ up to 8.5 cm. long by 2 cm. wide, quite entire, short-acuminate to rather long-acuminate, the basal ones deflexed, not reduced, the base equally truncate or subcordate, the larger ones with an obtuse auricle above, more or less embracing the rachis, with a distinct tuberculiform ærophore below; veins in 4–5 alternately united pairs, raised below, costæ shortly strigose above, the margins ciliate, the surfaces glabrous, the under side verrucose; texture herbaceous, colour dark green. Stipe of the fertile leaf 30–40 cm. long, the blade 20–30 cm., the largest pinnæ 3 cm. by 6–8 mm., the under side wholly covered with the confluent sori; sporangia light brown, without the setæ which are a frequent character in this group of ferns; indusia small, glabrous, fugacious.

This is as distinct as many others of the group. Its nearest ally is no doubt *D. exsculpta* (see above), which differs from our species by shorter, obtuse and crenate-lobate pinnæ and setose indusia and sporangia. *D. Hosei* differs chiefly by the decidedly unequal-sided base of the pinnæ. In the shape of the pinnæ *D. tenompokensis* also closely resembles *D. firmula* (see below) but this is not dimorphous. Cl. 27622 is larger than the type, having sterile pinnæ 9 by 2.5 cm.

D. labuanensis C. Chr.—Dallas, rocky stream margin (Cl. 30458). This specimen has setose sporangia and indusia.

D. mirabilis Copel. Phil. Journ. Sci. 6C: 137, pl. 19. 1911.—near Dallas, on rocks by stream in forest (H. 25147).

The type from Sarawak (Bidi, Brooks!) is a form with only one pair of lateral pinnæ, and I believe that *D. holophylla* (Bak.) C. Chr. from Niah (Hose 242, Kew) and Mt. Matang (Matthew), which has undivided fronds, probably represents the same species. The Kinabalu fern is pinnate with 4 pairs of pinnæ, the sterile ones 3 cm., the fertile less than 2 cm. wide. The species has also been collected in the Malay Peninsula: Kedah, Pulau Langkawi (Holtum 17436, with 1 to 3 pairs of pinnæ) and a much smaller form from Pahang, Bukit Senai (Henderson 19437), with 1 or 2 pairs of small lateral pinnæ below the large terminal pinna.

Small plants similar to Henderson's 19437, when brought into cultivation in Singapore, have grown into the typical larger form. The small size seems to be characteristic of plants growing in somewhat exposed situations on river banks. Such plants are common by some of the Pahang rivers, and have been collected also in Perak. (R.E.H.).

D. firmula (Bak.) C. Chr.—near Dallas, on ground near stream in forest (H. 25144, Cl. 26923, 27430), in moist shady forest near Dahobang river (H. 25596). Sarawak: Mt. Dulit (Hose 295, Mjöberg).

The Kinabalu specimens are large, but otherwise typical. Leaves uniform, almost entirely glabrous; pinnæ about 5 pairs, 12–15 by 3 cm., the lower ones cuneate at base, the upper rounded below and truncate and auricled above, entire; veins 5–6 pairs, sori near the main veins, exindusiate; sporangia not setose, but bearing red glands close to the annulus; ærophores present. Intermediate between *D. lineata* and *D. urophylla*.

D. urophylla (Wall.) C. Chr. var. **nitida** Holtum n. var.—a species typical differt: venulis valde obliquis, pagina superiore glaberrima, nitente, non pustulosa.

Menetendok, in secondary forest, abundant (H. 25592).

This variety is very similar in general form and habit to *D. urophylla* as found in the Malay Peninsula (type from Penang), but differs very strikingly in the two characters noted in the above diagnosis. The difference seems to me hardly sufficient to warrant a specific separation. The veins are much more oblique than in typical *D. urophylla*, and this gives them a closer appearance, though they are actually not more numerous; they are doubly curved into a long

slender S, in the same way as those of the typical form, but with the curvature a little more pronounced. The upper surface is usually very smooth and shining, and is not verrucose. All Bornean specimens in the *D. urophylla* cover in the Singapore herbarium belong to this variety, and also a specimen from Tawitawi island (Philippines), which is not far from the coast of B.N. Borneo. The variety probably represents the Bornean form of the species. As in Peninsula specimens, var. *nitida* varies somewhat in the cutting of the margins of the pinnæ, from repand-crenate to rather deeply and coarsely toothed; the bases of the pinnæ are usually cuneate, but may be rather broadly rounded. The fronds dry green or somewhat brownish, but not red.

This variety is very abundant in the low country round Kinabalu, in rather open grassy places by the bridle paths, often rather yellowish where most exposed, and in the secondary forest which springs up on the abandoned rice ladangs. In this habitat it differs from *D. urophylla* in the Peninsula, which is not usually found except in rather shady primitive forest. Other Bornean specimens are: B.N. Borneo: Sungei Bakong (Teruya, March 1932), Sandakan (Elmer 20306). Sarawak: s.l. (Bishop Hose, 1891), Lawas (Native collector 30, distr. E. D. Merrill). Dutch Borneo: W. Koetai, Lahœm, 40 m. (Endert 1853, distr. as *D. cuspidata*). Philippines: Tawitawi, Sulu Prov. (Ramos & Edano, Bureau of Science no. 44171, distr. as *D. moulemeinensis*).

SUBGENUS STEGNOGRAMMA (Bl.).

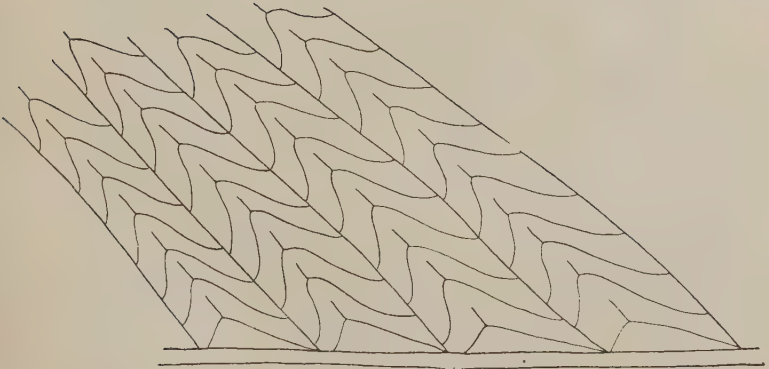
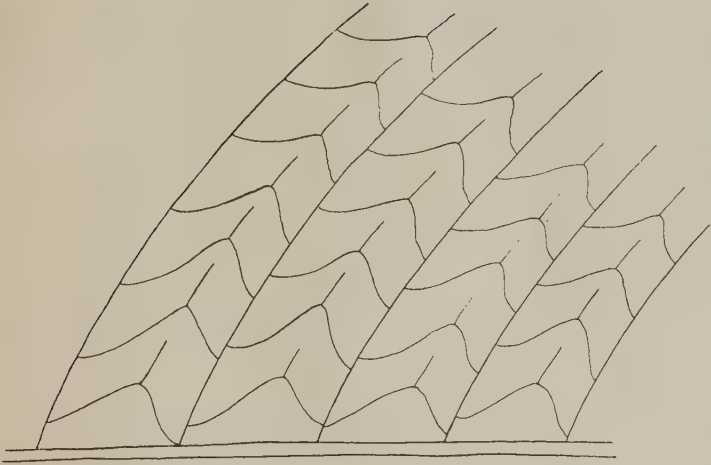
D. stegnogramme (Bl.) C. Chr.—Kamborangah, in wet forest near river (H. 25538).

This is the typical form, widely different from the Himalayan and south Chinese fern usually but wrongly referred to the same species.

SUBGENUS EUDRYOPTERIS.

D. hirtipes (Bl.) O. Ktze.—Lobang (Tp. 1769, H. 25557), Tenompok, on rocks by stream in forest (H. 25390, Cl. 29416, 28205). Locally abundant. H. 25557 has conspicuous indusia, but no indusia can be found on the Tenompok specimens, which thus agree with the Himalayan-Chinese *Phegopteris Scottii* Bedd.

D. paleacea (Sw.) C. Chr. Amer. Fern. Journ. 1: 94. 1911.—*D. filix mas* subsp. *patentissima* (Wall.) C. Chr. Index.—near Pakka, in forest near stream, not abundant (H. 25514, Cl. 28973).



DRYOPTERIS UROPHYLLA, venation, $\times 3$. Above, typical form, from Penang. Below, var. *nitida*.

The first specimen of this species I have seen from Borneo. It agrees closely with the Himalayan *Aspidium patentissimum* Wall., which I can distinguish at best as a variety from the South American *D. paleacea*. This is a tropical subspecies of the northern *D. filix mas* and is often so named; it occurs in very scattered localities on high mountains in tropical America and Asia, the Hawaiian islands and Madagascar.

D. sparsa (Ham.) O. Ktze.—near Menetendok, in forest near river (H. 25576), Tenompok (Cl. 27905, 28117), Lumu trail (Cl. 28384), Falls above Lumu (Cl. 29940). New to Kinabalu, rare in Borneo.

The specimens are all terrestrial, and some are much dwarfed.

D. polita Rosenst., Fedde Repert. 13: 218. 1914.—Tenompok (H. 25387, Cl. 27976, 28680), Silau basin, rocky place near stream at 6000 ft. (Cl. 29057).

This species is allied to *D. sparsa*, with which it has probably been confused by some authors; it is however clearly distinct, and except for its eudryopteroid venation it resembles rather *D. syrmatica* (Pteridrys) in some important characters, e.g. the grey-green colour, the wholly glabrous and broadly deltoid lamina with long-stalked pinnæ. It further differs from *D. sparsa* by its entire or bluntly crenate, not sharp toothed segments. In addition to the type locality in Sumatra, the species has been found in the Malay Peninsula at Cameron's Highlands, alt. 4400 ft. (Holttum 23451), and at Tonkin; it evidently has a wide distribution in the Malayan region.

D. subarborea (Bak.) C. Chr.—*D. tabacicola* v.A.v.R. Bull. Jard. bot. Buit. II ser. XVI: 11. 1914; Handb. Suppl. 174.—Lumu Lumu to Kamborangah, in more open ridge forest (H. 25456), near Kamborangah, in fern thicket by edge of river (H. 25531), Silau basin at 7000 ft. (Cl. 29696, 29875), without locality (Cl. 29710).

Like most large dissected ferns, this, the biggest species of the subgenus, is variable as to the degree of division. No. 25531 is the typical form, matching the type from Niah, Sarawak (Hose 174), with the tertiary segments all broadly adnate and decurrent at base and shallowly dentate only (the basal ones excepted). Stipe densely chaffy with linear, brown or fuscous scales. *D. tabacicola* is the same. No. 25456 is smaller but more dissected, most tertiary pinnules being free at base, sessile and rather deeply lobed; the scales on the stipe are much narrower.

SUBGENUS CTENITIS C. CHR.

D. adnata (Bl.) v.A.v.R. Handb. Suppl. 501. 1917. *Aspidium adnatum* Bl. Enum. 162.—*D. filix mas* Copel.

Keys 358.—*Polystichum truncatulum* v.A.v.R. Bull. Jard. bot. Buit. II Ser. XVI: 60, pl. 8. 1914.—Pakka to Lobang (Cl. 10723), at 11500 ft., in rock crevices, in bushy thicket on granite core of mountain (H.

This very distinct species has been much misunderstood by authors who have almost all (my Index included) referred it to *D. filix mas*. It certainly resembles that species very much in general habit, but the two species are in my opinion very remotely related, while on the other hand *D. adnata* is closely allied to *D. apiciflora* (Wall.) O. Ktze. Both the two last named species differ from *D. filix mas* and all other species of *Eudryopteris* by the costæ being rusty tomentose above with intestiniform hairs, by which character they agree with all species of the subgenus *Ctenitis*, and I place them therefore tentatively in this, though it must be admitted that they are rather isolated species. The frond of *D. adnata* is bipinnatifid, and like other members of the subgenus of a characteristic brown colour when dried; the stipe, rachis and costæ beneath are rather densely chaffy with reddish brown, ovate-acuminate entire scales, the rectangular segments crenately lobed or subentire (in this respect also wholly different from *D. filix mas* and its relatives, the segments of which are sharply dentate). The sori are medial, not confined to the distal part of the segment as in *D. apiciflora*, furnished with rather small, subpersistent, reniform glabrous indusia. According to Copeland, the same form as found on Kinabalu occurs also in the Philippines; the type is from Java.

D. dissecta (Forst.) O. Ktze.—Near Menetendok, on rocks by river, pendulous (H. 25571).

This is exactly the same as the Philippine fern first described as *Nephrodium membranifolium* Presl. (t. orig. in Herb. Presl), which has been badly confounded with a very similar fern with pleocnemoid venation (*Aspidium membranifolium* Index, now *Tectaria fuscipes* (Wall.) C. Chr., Contrib. U.S. Nat. Herb. 26: 290. 1931). Two questions remain to be settled: (1) whether the forms with free and anastomosing veins and now placed in two genera are really specifically different, and (2) whether the true Polynesian *Polypodium dissectum* is the same as *N. membranifolium* Pr. In every case these forms of subcompound species prove that we find a gradual transition between the subgenus *Ctenitis* and *Tectaria*, group of *T. cicutaria*.

D. aciculata (Bak.) C. Chr.—Tenompok, in forest near stream, stock short decumbent (H. 25253), Dallas-Tenompok ridge (Cl. 26846).

Rather larger than the type from Sarawak (Hose 86), but I have exactly the same from Mt. Merinjak, Sarawak. It is surprisingly like *Tectaria Leuzeana*, but much more scaly and the veins free, and is another instance of the close relationship of *Ctenitis* and some species of *Tectaria*. It is the largest species of a group of Asiatic species, e.g. *D. vilis* (Kze.) C. Chr. (*Aspidium intermedium* Bl.), *D. rhodolepis* (Cl.) C. Chr.

SPECIES OF UNCERTAIN RELATIONSHIP.

Dryopteris Hasseltii (Bl.) C. Chr.—*D. laserpitiiifolia* (Scort.) C. Chr.—Tenompok, in forest (Cl. 28598).

This belongs to a small group of Asiatic species, the position of which is still uncertain. Some of them, e.g. *D. obovata*, approach *Athyrium*. I have hitherto placed them in the subgenus *Polystichopsis*, but they do not really belong there. *D. laserpitiiifolia* from the Malay Peninsula is quite identical with *D. Hasseltii*; it occurs also on the mountains of Sumatra.

D. Boryana (Willd.) C. Chr.—Near Menetendok, among rocks (H. 25583).

New to Borneo. This species, together with one or two near relatives, is placed by all authors in *Dryopteris*, and for some time I considered it a rather isolated species of the subgenus *Ctenitis*. Recent studies, chiefly of Chinese and African species, have convinced me, however, that it is not a *Dryopteris* at all, but a near ally of some decompound species of *Athyrium*, e.g. *A. Atkinsoni* Bedd. Whether it may be referred naturally to that genus, or eventually to a new genus, must be decided by further studies.

I cannot distinguish *D. Kingii* (Bedd.) C. Chr., from Perak (Kunstler 2250), from *D. Boryana*.

DIDYMOCHLÆNA DESVAUX.

D. truncatula (Sw.) J. Sm.—s.l. (Burbidge), Kiau (Gibbs 4098), Dallas-Tenompok ridge (Cl. 30455), near Menetendok (H., s.n., Cl. 29630). Nowhere on Kinalu an abundant species.

MESOCHLÆNA R. BROWN.

M. Toppingii Copel. 1917: 57.—Koung to Kabayau (Tp. 1902), near Dallas on wet bank near stream (H. 25130, Cl. 27458), Dallas-Tenompok ridge (Cl. 26908).

Scarcely more than a local variety of *M. polycarpa*, of which I have a specimen from Sumatra with many similarly much reduced sagittate pinnæ.

POLYSTICHUM ROTH.

GROUP OF *P. ACULEATUM*.

In his Keys, p. 366, Copeland referred three distinct ferns to the comprehensive *P. aculeatum*, being unable to identify them. The agreement of his specimens with those collected by Mr. Holttum enables me to distinguish the following four species.

P. kinabaluense C. Chr. n. sp.—Rhizomate decumbente vel breve repente, crasso, paleis rufis, ovatis lanceolatisve, fimbriatis dense vestito. Stipitibus 10–20 cm. longis, paleis rufis, lanceolatis, longe fimbriatis et aliis filiformibus ornatis, denique denudatis. Lamina deltoideo-lanceolata, 15–20 cm. longa, basi 4–8 cm. lata, acuminata, rigide coriacea, bipinnata; rachi paleis rufis fimbriatis, aliis latis aliis angustissimis dense vestita. Pinnis basalibus maximis, 3–4 cm. longis, 1 cm. latis, acuminatis, omnibus parte dimidia inferiore pinnatis, superiore pinnatifidis, pinnulis liberis 6–8-jugis, trapezoideis, 5 mm. longis, 3 mm. latis, subpetiolatis, utrinque pungenti-dentatis, apice longe spinescente, dentibus rigidis; costis utrinque laxe paleaceis, serius nudis, pagina inferiore paleis filiformibus sparse conspersa, cito nuda. Soris medialibus, sat parvis, indusiis non visis.

KINABALU: Pakka to Low's Peak (Cl. 10648, type, Herb. Bur. Sci. Manila, Herb. Kew.), at about 12000 ft., in crevice, under overhanging rock (H. 25490, exactly typical), below Kamborangah ? (Cl. 27968). Plate 52.

A high-alpine species of the *aculeatum*-complex, characterised by the long stipe and small subdeltoid bipinnate lamina of rigid texture. Clemens 27968 has rather larger fronds and shorter stipes than the other specimens.

P. obtusum J. Sm.—Below Kamborangah, on steep rocky slope in forest (H. 25714, 25534, Cl. 27948?), falls above Lumu (Cl. 29937).

Differs from the former species by its much large size, the pinnæ pinnate nearly to the tip, the pinnules subentire with few or no aristate teeth below the apex. No. 25534, collected near the river, is larger and thinner in texture than no. 25714, from a dry rocky place.

var. **densum** v.A.v.R. Bull. Jard. bot. Buit. II ser. I: 12. 1911. XI: t. 6. 1913.—Silau basin, jungle ridges at 7–8000 ft. (Cl. 29629), Kamborangah (Holttum 25525bis).

The specimens quoted are very large, agreeing in size with the variety described by v.A.v.R. The pinnules are deeply serrately lobed, the lobes not aristate. The basal

pinnules of the lower pinnæ have free auricles. The scales are exactly as in the typical form of the species.

P. Holttumii C. Chr. n. sp.—Rhizomate ? (verisimiliter erecto), stipitibus 60 cm. longis, densissime paleaceis; paleis rufis concoloribus, mollibus, aliis ovatis 5–6 mm. latis tenuiter ciliatis, aliis lanceolatis in apicem longissimum filiformem contortum attenuatis, aliis parvis numerosioribus dense ciliatis crispatis, stipitem dense tegentibus. Lamina lanceolata, ad 60 cm. longa, 25 cm. lata, versus basin angustata, herbacea, subtripinnata; rachi ut stipite dense paleacea. Pinnis alternis, sessilibus, linearibus, acuminatis, maximis 14 cm. longis, 1.5 cm. latis, inferioribus sensim brevioribus (infimis 7–8 cm. longis). Pinnulis densis, ad 25–jugis, parum obliquis, 8 mm. longis, basi 4 mm. latis, basali acroscopica producta, postice cuneatis antice subauriculatis, apice obtusis vel subacutis, raro breve mucronatis, margine incrassatis sine dentibus, basi auricula obovata, integra, libera instructa, sursum lobatis, lobis 2–3–jugis, obtusis. Costis inferne ut rachi dense rufo-paleaceis, superne parce fibrillosis. Soris parvis, medialibus, indusiis rufis, glabris, subpersistentibus.

KINABALU: Pakka (H. 25513, type in Herb. C. Chr., Cl. 27972; also probably Cl. 27973 & 28971, small immature plants). Plate 53.

A very beautiful fern, abundantly different from the preceding species, but near the more dissected forms of the European *P. setiferum* (Forsk.) Woynar (*P. aculeatum angulare* auctt.), but much more scaly and without aristate teeth.

P. gemmiparum C. Chr. n. sp.—Rhizomate oblique erecto. Stipitibus ad 30 cm. longis, stramineis, dense paleaceis, serius delapsis denudatis muricatisque; paleis mollibus, rufo-brunneis, concoloribus, inferioribus ovatis superioribus lanceolatis et filiformibus, omnibus parce fimbriatis et in apicem filiformem desinentibus. Lamina e basi usque ad 25 cm. lata, versus apicem gradatim attenuata, 40–50 cm. longa, 5–10 cm. infra apicem gemmam rufo-squamosam ad rachin nascente, utrinque pallide viridi, papyracea, bipinnata vel foliis minoribus bipinnatifidis; rachi straminea, ut stipite paleacea, paleis plerisque filiformibus, læte brunneis. Pinnis alternis, subfalcatis, inferioribus maximis ad 12 cm. longis, breve petiolatis, ceteris sensim brevioribus, sessilibus, omnibus basi postice cuneatis, antice truncatis et breve auriculatis, apice argute acutis rarius acuminatis, maximis 3 cm. latis, parte inferiore pinnatis sursum profunde pinnatifidis, medialibus

lobatis, superioribus subintegris. Pinnulis laciniisque valde obliquis, trapezioideo-ovatis, postice decurrente antice rotundato-excisis, rarius subauriculatis, maximis 5–6 mm. latis (basali acroscopica majori), contiguis, integris vel majoribus 1–2 dentibus brevibus instructis, apice breve aristatis. Pagina superiore nuda, inferiore paleis læte brunneis, lanceolatis, fimbriatis ubique, ad costas densius conspersa. Soris parvis, medialibus, indusiis pallidis, glabris, mox delapsis.

KINABALU: near Lobang, on rocks by stream (H. 25561, type in Herb. C. Chr., Cl. 10353), Tenompok (H. 25394, Cl. 28094). Plate 54.

This species is closely allied to *P. prolificans* v.A.v.R. (Bull. Jard. Bot. Buitenz. III Ser. vol. 2: 170. 1920) from north Sumatra and the Malay Peninsula (Penang and Perak only), but differs by its considerably smaller size, the pinnules never deeply divided, and the concolorous scales. (R.E.H.).

P. gemmiparum also closely resembles *P. eximium* (Mett.) C. Chr. (*Aspidium* Mett.), from Ceylon (Thwaites 3275) and many other localities, in colour and shape of segments, but it is smaller, less divided, and constantly gemmiferous, the sori not inframedial, indusiate. In general habit it is not unlike the Brazilian *P. platyphyllum* (Sw.) Pr.

This fine species I originally described after Clemens 10353 (Herb. Bur. Sci. Manila), but the description above is taken from Holttum's larger specimens, and his no. 25561 must therefore be held as the type.

P. punctulatum v.A.v.R. Bull. Jard. bot. Buitenz. III ser. 2: 171. 1920.—Near Tenompok, on exposed bank by path (H. 25359), Tenompok (Cl. 26641, 27328, 28032, 28102), Koung-Kabayau, steep hillside above river, at 100 ft., abundant (Cl. 27660).

Holttum's plant is an extremely coriaceous, small form, in habit and size much resembling *P. varium* (L.) Pr., but lacking bullate scales and as to other characters agreeing better with *P. punctulatum*. Rhizome short, erect; the lamina deltoid, 25 cm. long by 15 cm. wide, bipinnate, only the slightly prolonged lower pinnules of the basal pinnae pinnatifid; leaf-tissue between the veins vaulted, the under side being consequently furrowed; sori supra-medial, rather large, apparently exindusiate, but the indusia perhaps all fallen. The specimen represents apparently an unusually small and coriaceous form of the species (possibly in part owing to an exposed habitat), of which more typical examples are: Matang, Sarawak (Hose, at Kew); Gunong Tahan, Pahang (Holttum 20779).

Clemens 27660, from a lower altitude, is larger than H. 25359, and less coriaceous. In size and cutting it agrees very nearly with the type of *P. puncticulatum*, differing in having the teeth of the pinnules more acute, in some cases the apices almost aristate. There is some variation in the teeth of other specimens. (R.E.H.).

This species, originally described from Sumatra, is now known to occur in the Malay Peninsula and Borneo. It is closely allied to *P. speciosum* (Don.) J. Sm., and Peninsula specimens were formerly referred to that species.

P. aristatum (Forst.) Pr.—Gurulau spur (Gibbs 2980), Kamborangah to Pakka (Gibbs 4222), near Lobang, rocky ground near river, in forest (H. 25566).

Both Miss Gibbs's specimens were named by Gepp and I have not seen them; they may belong either to the former or to the following species.

P. carvifolium (Kunze) C. Chr.—Marei Parei ridge (Cl. 11037), Kamborangah abundant on ground in forest (H. 25525, Cl. 28976), Tenompok to Lumu Lumu (H. 25439 ?, Cl. 27969, 29974), Silau basin at 9,000 ft. (Cl. 29053).

Not quite like the Indian type, especially differing in the broader and dark brown rhizome scales. It is much more divided than *P. aristatum*, being 4-pinnate.

The three last-mentioned species would perhaps be better referred to *Dryopteris* subgenus *Polystichopsis*.

CYCLOPELTIS J. SMITH.

C. Presliana (J. Sm.) Berk.—Near Koung, on shady rocks by bridle path, and by streams (H. 25626).

HETEROGONIUM PRESL.

An excellent genus, restored by Copeland in 1929 (Univ. Cal. Publ. Bot. 16: 61), much more closely related to the group of *Dryopteris sagenoides* (which should be segregated from *Dryopteris*) than to any species of *Tectaria*, to which genus it has hitherto been referred. The two known species occur in Borneo. The more widely distributed type-species is *H. aspidioides* Presl (synonym: *Aspidium ambiguum* Diels, Index), which has been recently collected near Sandakan by Boden Kloss (no. 19034); its veins are free outside the costal and costular areoles. The other species has been found on Kinabalu, as described below.

H. profereoides (Christ) Copel. l.c.—*Aspidium profereoides* Chr. Phil. Journ. Sci. 2 C: 158. 1907.—Near Dallas, in forest near stream (H. 25257, Cl. 27484), Tenompok (Cl. 28942, 28453). Formerly known from Mindanao only.

The specimens agree exactly with the original description, and differ from *H. aspidioides* chiefly in venation. Between the narrow costal areoles and the sinuses are 3 or 4 rows of angular areoles without included veinlets, and outside the larger costular areoles are usually one or two more rows. The dark green leaves are subdimorphous, the fertile ones narrower; the sori are dark brown, oblong to linear, mostly confined to the lobes, arranged in rather regular rows, one each side of the costules. The sterile pinnæ are about 15 cm. long by 3 to 3.5 cm. wide, lobed half-way down, the lobes 7-8 mm. wide, entire, the basis-copic lobes of the basal pinnæ somewhat prolonged. In all other characters the species is very like *H. aspidioides*.

TECTARIA CAVANILLES (*Aspidium* Index).

As usually defined, this is a composite genus, including several natural groups which are not closely related to each other.

T. Leuzeana (Gaud.) Copel. Phil. Journ. Sci. 2 C: 417. 1907.—Kiau (Cl. 10241), near Lobang, in rather open forest on steep slope (H. 25545), Tenompok (Cl. 28749, 29111, 28852, 28287, 29629), Dallas-Tenompok ridge, in Jungle (Cl. 27518).

A very abundant fern near Tenompok, usually on the edge of the forest, sometimes reaching a very large size.

T. Holttumii C. Chr. n. sp.—Habitu, divisione, stipite rachique ebenei *T. melanocauli* (Bl.) Copel. similis, ab ea specie abunda differt: folio toto pilis brevibus, moniliformibus molliter et sat dense pubescente, soris irregulariter conspersis, minimis, indusiis perparvis, peltatis.

KINABALU: near Menetendok, on rocks by river Kadamaian (H. 25570, type in Herb. C. Chr.; Cl. 29516), Dallas (Cl. 27313). Plate 55.

Stipe to 35 cm. long, ebeneous, shortly brown-pubescent, at base with some narrow brown long-acuminate entire scales. Lamina broadly deltoid, 25-30 cm. long and wide, herbaceous, brown when dried, rather densely and softly pubescent throughout with moniliform hairs, consisting of a pair of lateral pinnæ and a terminal pinnatifid portion. Pinnæ to 15 cm. long, short-stalked, acuminate, lobed and coarsely serrate in the outer half, pinnatifid in the inner, the lower side much produced, the basal basis-copic segment 9 cm. long and 2 cm. wide, coarsely serrate, acuminate, the basal acroscopic one triangular acute, 2 cm. long; the apical portion of the frond 20 cm. long and nearly as broad, in division like the basal pinnæ but equilateral, cut in the lower part into a wing 1 to 1.5 cm. on either side of the rachis, the

larger segments in three pairs, the lowest ones 15 cm. long and 3 cm. wide, more deeply serrately lobed on the lower side; costæ ebeneous beneath in the lower third, brown distally; veins densely reticulated between the distinct main veins, the areoles small with free included veinlets. Sori irregularly scattered, very small, sometimes dorsal on the netted veins, or more often apical on extremely short branches; indusia peltate, very small, brown.

Though resembling *T. melanocaulon* in habit, this new species is not nearly related to it, but belongs to a group of closely allied species several of which occur in Borneo, e.g. *T. labrusca*, *T. platanifolia*; *T. Holttumii* agrees with these species in pubescence, texture, colour, venation and sori, but it is much more divided than any previously known species of the group.

In Clemens 27313 there are two pairs of lateral pinnæ, the lowest about 22 cm. long. The type is therefore a rather small specimen.

T. coadunata (Wall.) C. Chr. Contr. U. S. Nat. Herb. 26:331. 1931. *Aspidium cicutarium* subsp. *coadunatum* C. Chr. Index.—Near Menetendok, on rocks by river, frond pendulous (H. 25587). New to Borneo.

I cannot distinguish this specimen from the common Himalayan and South Chinese form.

T. malayensis (Christ) Copel. Phil. Journ. Sci. 2C: 416. 1907.—Kiau (Tp. 1541), Kabayau to Koung, on shady banks near stream (H. 25108), near Dahobang river, in forest (H. 25598), Dallas-Tenompok ridge, in ravine (Cl. 26845, 27329).

T. decurrens (Pr.) Copel. l. c. 412.—Menetendok gorge (Cl. 10444), Tenompok trail at 4,000 ft. (Cl. 26859).

T. crenata Cav. (t. sp. orig. herb. Cavanilles).—*Aspidium pachyphyllum* Kunze, C. Chr. Index.—*A. repandum* Willd.—Tenompok, in forest by stream (H. 25404, Cl. 29411, 26931).

Pinnæ lanceolate, 7–8 jugate (or more), the basal ones with a basisopic lobe, the upper confluent with the pinnatifid or trifid terminal pinna.

T. pleiosora (v. A. v. R.) C. Chr. comb. nov. *Aspidium pleiosorum* v. A. v. R. Handb. Suppl. 199. 1916.—Dallas (Cl. 27295, H. 25726). Also Kudat (H. 25101) and Semanuag river near Sandakan (Kloss 18691).

This species is very near *T. crenata*. The lateral pinnæ are paucijugate, ovate-lanceolate, the lamina on the acroscopic side of the midrib distinctly narrower than that on the basisopic side (especially in the lower pinnæ), the basal pinnæ simple or rarely lobed (Cl. 27295 has one frond with lobed basal pinnæ), the terminal pinna free or confluent

with the uppermost pair of lateral ones, in the latter case cuneate or almost truncate at the base. The texture is usually more or less coriaceous. The fertile fronds are smaller than the sterile, with shorter and narrower pinnæ. The Kudat specimen quoted has buds on the rachis at the base of the terminal pinna.

The specimens referred here differ in various points, as the above description indicates, but they all agree in having few and broad pinnæ and are thus very different in aspect from typical *T. crenata*, which over a wide geographical range is very uniform in character. Some of the plants around Dallas have unusually broad and coriaceous pinnæ. They were abundant in shady forest slopes near streams, but during my visit were almost all sterile. As in some other species of *Tectaria*, the production of fertile fronds is probably seasonal. (R. E. H.).

T. vasta (Bl.) Copel. Phil. Journ. Sci. 2C: 411. 1907.—s.l. (Low), Koung to Kabayau (Tp. 1910), Kabayau to Koung, abundant on banks near streams (H. 25107). Also Kudat (H. 25103).

Holtum's two specimens are vegetatively quite identical, but while the sori of no. 25107 are apparently exindusiate those of no. 25103 are furnished with small but distinct indusia. In both cases the sori are small and round, not elongate.

T. trifolia (v. A. v. R.) C. Chr. comb. nov. *Aspidium trifolium* v. A. v. R. Bull. Jard. bot. Buitenz. II ser. no. VII: 4. 1912.—*A. terminale* Rosenst. Meded. Rijks Herb. Leiden no. 31: 4. 1917. C. Chr. Gard. Bull. S. S. 4:393, with description.—Kabayau (H., s. n.). Also Kudat (H. 25104).

This species was based on trifoliate specimens from Luzon; in other respects however they are fully identical with Rosenstock's species. Evidently this is a widely distributed fern in the Malayan region. I am inclined to consider it a form of the Sumatran *Aspidium nebulosum* (Bak.) C. Chr.

CAMPIUM PRESL, COPELAND PHIL. JOURN. SCI.

37: 341. 1928, *partim*. (*Leptochilus* C. Chr. Index).

C. subsimplex (Fée) Copel. l.c. 356, pl. 8.—Near Dallas, on rocks by stream and in stream bed (H. 25141, 25352), Tenompok, rocky stream in forest (Cl. 27653, 28234).—Sarawak: Segorah river (Brooks, Kew).

New to Borneo, known previously from the Philippines and the Malay Peninsula (Perak, King's Collector 8398, and many recent collections). The Bornean specimens have nearly all simple fronds only, and are without buds. Clemens 28234 has trifoliate fronds. Peninsula specimens

(hitherto usually referred to *Leptochilus Zollingeri*) are nearly always pinnate, except young plants. This species is common on rocks by forest streams in the Peninsula, chiefly at low altitudes.

C. quoyanum (Gaud.) Copel. l.c. 366.—*Leptochilus cuspidatus* C. Chr. Index.—Near Menetendok, on wet rocks by river, the rhizome clinging to the bare rocks (H. 25585).

A form with very few areoles, about as Copeland's fig. 20 d.

LOMARIOPSIS FÉE.

L. leptocarpa Fée.—Dallas-Tenompok ridge (Cl. 27596), climbing small trees to a height of 30 feet.

For a discussion of this species, see Holttum, Gard. Bull. S. S. 5: 270.

TERATOPHYLLUM METTENIUS.

(Holttum in Gard. Bull. S. S. 5:277.1932).

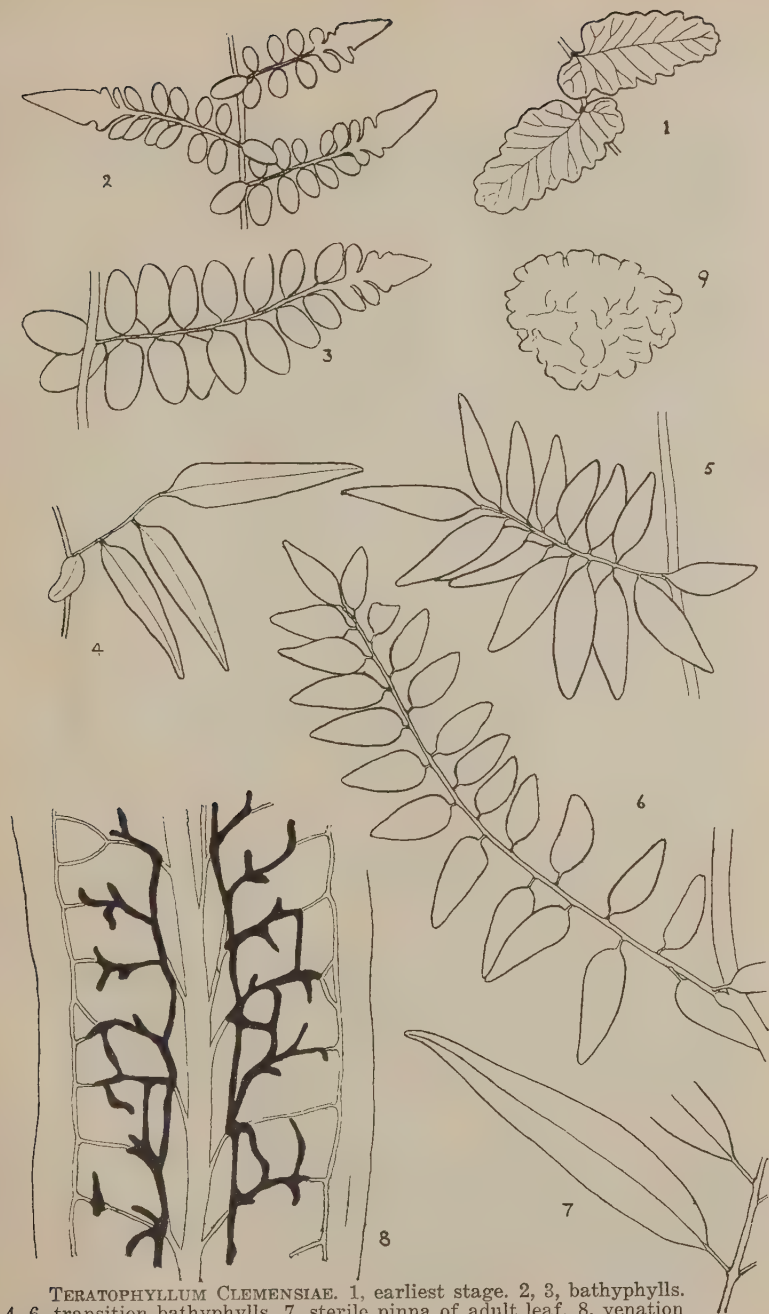
T. Clemensiae Holttum sp. nov. *T. rotundifoliatum* (Bonap.)

Holttum affine, differt: bathyphyllis pinnatis, pinnis subintegris; pinnis frondium fertilum c. 5 mm. latis, venis prope marginem unitis, venis soriferis irregulariter transversis.

Youngest stage.—Leaves indistinguishable from those of *T. rotundifoliatum* (Holttum l.c. 285,294), but usually a little larger, to 3 cm. long and 1.5 cm. wide near base, the lower base broadly cordate and overlapping the rhizome, the upper base cuneate, the edges broadly lobed, lobes round, the apex broadly rounded.

Normal bathyphylls.—The smallest of these show transitions from the youngest stage. They are narrowly deltoid, about 4.5 cm. long, base 2 cm. wide, with 3 or 4 pairs of free pinnæ below the deeply lobed triangular apex; the free pinnæ are sessile, elliptic-obovate, edges entire or slightly sinuate, base unequally cuneate, apex rounded; the lowest pinna on the lower side is reflexed and overlaps the rhizome. The largest normal bathyphylls seen are about 9 cm. long by 4 cm. broad, the pinnæ about 9 pairs below the lobed triangular apex, largest pinna about 2.2 cm. long by 1.0 cm. wide, base very broadly cuneate, widest near base and narrowed slightly to the broadly rounded apex, edges sinuate; the lowest pinna always reflexed and overlapping the rhizome at right angles.

Transition bathyphylls (pinnæ all articulate). These are of several different types on different specimens, and appear to vary according to conditions of environment. The character they have in common is that all pinnæ are



TERATOPHYLLUM CLEMENSIAE. 1, earliest stage. 2, 3, bathyphylls. 4-6, transition bathyphylls. 7, sterile pinna of adult leaf. 8, venation of fertile pinna; soral veins black. 9, spore. All half natural size except: 1, $\times \frac{3}{4}$; 8, $\times 8$; 9, $\times 175$.

entire (or nearly so) and of shape similar to those of the adult fronds; as in almost all bathyphylls, the lowest pinna is reflexed to overlap the rhizome at right angles. Three different types may be briefly described, but there are intermediate forms also.

(1) Dimidiate type. Fronds consist of a terminal pinna with 1 to 3 lateral pinnæ on the lower side only, upper side of rachis without pinnæ; lateral pinnæ sometimes absent, the reflexed basal one often so. Terminal pinna 5-9 cm. long, 1.2 to 2 cm. wide; lateral pinnæ somewhat smaller. Texture thin, probably indicating a moist habitat. These fronds have been found on the same piece of rhizome with small normal bathyphylls.

(2) Fully pinnate, small. Fronds 7-12 cm. long, 4.5-8 cm. wide, pinnæ 6-8 pairs, close (usually touching each other), short-stalked, largest pinnæ about 5 cm. long by 1.2 cm. wide, broadest near the broadly cuneate base, gradually tapered to the narrowly rounded apex, edges entire or slightly sinuate, texture subcoriaceous. Pinnæ on the lower side of the rachis usually somewhat larger than those on the upper side.

(3) Fully pinnate, large. Fronds to 18 cm. long by 6 cm. wide, pinnæ, about 10 pairs, on stalks 3 mm. long, those on lower side of rachis about 1.5 times larger than those on upper side, largest pinnæ about 3.5 cm. long by 1.3 cm. wide, broadest near the broadly cuneate base, narrowed evenly to the slightly rounded apex, texture subcoriaceous.

Adult plant. Rhizome.—Diameter to about 5 mm. colour green, somewhat muricate, surface of younger parts more or less densely covered with scales (*see below*), leaf-bases (to which the leaves are articulate) swollen and prominent.

Sterile fronds.—Usually about 40 cm. long (including stipe) and 17 cm. wide; largest seen 70 cm. long by 25 cm. wide. Stipe of smaller fronds 5 cm. long, of largest frond 15 cm. Rachis very narrowly winged in distal part only. Pinnæ about 10 pairs, alternate, all articulate, on stalks 5-10 mm. long, largest seen 15 by 2.3 cm., more usually about 8 by 1.5 cm., broadest near base, tapering gradually to an acuminate apex, base broadly unequally cuneate; texture thin but firm, colour usually rather light green; midrib prominent above and below, usually pale; veins about 2 mm. apart, slightly prominent on both surfaces, simple or forked, ending just within the margin; margin slightly reflexed, narrowly cartilaginous, and regularly sinuate, the prominent parts opposite the vein endings.

Fertile fronds.—Two seen, 40 cm. long, 10 cm. wide, stipe about 10 cm, pinnæ 10–12 on each side, petiolules 10 mm., lamina 5–7 cm. long, about 5 mm. wide; lower surface, except for the pale thin edge, covered with sporangia; veins uniting in a submarginal vein, with soral veins, close to the lower surface, irregularly crossing the areolæ so formed.

Scales scattered over surfaces throughout all parts of the plant, largest on rhizome and smallest on leaf-surfaces, castaneous, lanceolate, base peltate, edges bearing glandular hairs, largest about 1 mm. long, all more or less deciduous.

KINABALU: Penibukan, on *Polyalthia* tree, Clemens 31614, type in Herb. Singapore; also Cl. 31346 (sterile). Tenompok, Clemens 29566.

This species is closely allied to *T. rotundifoliatum*, both the youngest stage and the adult sterile fronds of the two species being hardly distinguishable; the only character in which the adult sterile fronds differ at all clearly is in the margins of the pinnæ which in *T. Clemensiae* are finely sinuate. The bathyphylls of the two species however differ so markedly as to distinguish them very sharply; *T. rotundifoliatum* has beautiful bipinnate fronds with almost circular pinnules, *T. Clemensiae* simply pinnate fronds with almost entire pinnæ. The transition bathyphylls also differ, those of *T. rotundifoliatum* having very narrow deeply lobed pinnæ, those of *T. Clemensiae* broad entire pinnæ like those of the adult fronds. The distinction of the fertile pinnæ seems also to be a good one. The fertile pinnæ of *T. Clemensiae* are only half as wide as those of *T. rotundifoliatum*; and the veins unite in a submarginal vein which is absent in *T. rotundifoliatum*; the soral veins of *T. Clemensiae* are also much less regular than those of the other species.

This species gives further evidence that in Teratophyllum the bathyphylls or early stages of development may be as important diagnostically as the adult form of the plant, or even more important; the necessity for full and careful collection of all stages is evident, and we are fortunate to have such a fine series of specimens of the present species, which I have pleasure in dedicating to Mrs. Clemens.

LOMAGRAMMA J. SMITH.

L. Brooksii Copel. Phil. Journ. Sci. 3c: 345 1908.—Near Dallas (H. 25251), Tenompok (Cl. 28638).

No fertile specimens were collected. Young plants, creeping on wet rocks by streams, have slender rhizomes and more or less erect fronds (depending on the inclination of the rock surface) on rather long stipes. The stipes of

some specimens collected by Clemens are 35 cm. long. The pinnæ of these fronds are at most about 7 cm. long by 2 cm. wide, the edges parallel for most of their length, the upper base very broadly truncate, the lower narrowly truncate or rounded, the apex falcate and shortly attenuate, the edges quite entire or slightly toothed towards the apex; the lower pinnæ are gradually reduced.

Older plants, or at least plants which have begun to climb a tree, have a thick rhizome closely similar in appearance and structure to the rhizome of *Lomariopsis* spp.; their fronds are of full size, and grow out horizontally from the tree. These fronds have short stipes as described by Copeland, and the basal pinnæ are gradually smaller. The upper pinnæ are oblanceolate, broadest one-third from the apex, the base suddenly truncate or broadly cuneate (less unequally than in young fronds), the apex less falcate than in young fronds.

Judging from my field experience in the Peninsula and in Borneo, I believe that the species of *Lomagramma* are often more easy to distinguish from their young creeping stage than from fronds of mature climbing plants; in this they agree with *Teratophyllum*. I am sure at least that we shall not have a proper knowledge of the species of *Lomagramma* until all stages have been collected for all species. As the plants rarely produce fertile fronds, they are apt to be neglected by collectors, no doubt from the idea that sterile material is useless; actually in this genus full sterile material of all stages is quite adequate to characterise the species, and the fertile fronds are usually the least distinctive features specifically. (R. E. H.).

ATHYRIUM ROTH.

This genus is here taken in the sense of my Index Filicum (*see* the remarks under *Diplazium* on p. 268). Most species found on Kinabalu belong to a specialised group characterised by often much-divided leaves of a dark green (when dried nearly black) colour, and dark axes.

A. macrocarpum (Bl.) Bedd.—Pakka (Cl. 10586, H. 25526), above Marei Parei (H., s. n.), Silau basin, among rocks, 3,000 to 7,000 ft. (Cl. 29033), Lumu trail (Cl. 27947).

A form of this polymorphous species with narrow, bipinnatifid leaves and strongly auricled pinnæ, much resembling the form described as *A. anisopteron* Christ.

A. Clemensiae Copel. 1917: 58.—Low's Peak (Cl. 10621, 29034, 27007, Boden Kloss s. n. 1928), in rock crevices at 12,000 ft. (H. 25486), Pakka to summit (Tp. 1698, 1705, Cl. 27049, 27944, 27782). Also a collection of Clemens labelled Tenompok ? (no. 28965).

A. Moultoni Copel. Journ. Str. Br. R. Asiatic Soc. no. 63: 71. 1912.—Pakka cave to Lobang (Tp. 1756, Cl. 10725 ?), below Pakka, occasional, in more shady parts of ridge forest (H. 25518, Cl. 27967, 28975).

Topping 1756 was referred to this species by Copeland, and perhaps rightly, though it does not quite agree with the type from Bukit Lawi. The other specimens quoted are exactly identical, and belong here, I think. They are large: the stipe up to 1 metre long, lamina tripinnate-quadripinnatifid, deltoid, the lower pinnæ 30 cm. long, 10 cm. wide. The colour, scales and sori are as in the type. I find however a peculiar difference, and am therefore not quite sure that these specimens are *A. Moultoni*. In many species of *Athyrium* the raised edges of the sulcate costæ or costules are prolonged (on the upper side) into fleshy spines at the base of each pinnule or segment. In the specimens above quoted these raised edges are high, wing-like, and at the base of the pinnules considerably widened, suddenly abrupted, and run with a bluntly rounded outer edge from the costule along the base of the midrib of the tertiary pinnule, resembling an auricle which is closely appressed to the upper side of the quaternary segment.

A. atropurpureum Copel. 1917: 59.—Low's Peak (Cl. 10620, Tp. 1696).

A. pulcherrimum Copel. Phil. Journ. Sci. 8C: 141, pl. 3. 1913.—Pakka cave (Tp. 1716, H. 25507, Cl. 30446).

More dissected than the Javanese type, tripinnate-quadripinnatifid. In size, texture, colour and cutting, a perfect mimicry of *Leucostegia hymenophylloides*.

A. amoenum C. Chr. n. sp. affinis *A. pulcherrimo*, textura tenuior, magis divisa. Rhizomate? Stipite 35 cm. longa, superne bisulcato, brunneo, præsertim versus basin paleis rufo-brunneis, late lanceolatis acuminatisque, mollibus, sat dense oblecto. Lamina deltoidea vel latissime ovata, ad 50 cm. longa, 30–35 cm. lata, obscure viridi, textura tenuissima, quadripinnatipinnatifida, rachi nuda et ut tota planta glaberrima. Pinnis 9–10-jugis, inferioribus oppositis, 9 cm. inter se remotis, sessilibus vel brevissime petiolulatis, late ovato-lanceolatis, ad 20 cm. longis, 10 cm. latis, breve acuminatis, versus basin paulo angustatis, superioribus alternis, costis paleis parvis luteo-brunneis sparse onustis. Pinnulis II alternis, breve petiolatis, maximis 5–6 cm. longis, 1.5 cm. latis, basi latere acroscopico aliquot producto inæquilateralibus, acutis, basalibus pinnarum infimarum I ord. abbreviatis; pinnulis III 1 cm. longis,

petiolatis, basi postice cuneatis antice truncatis, productis, parte dimidia inferiori pinnatis, sursum profunde pinnatifidis; pinnulis vel segmentis IV lobatis vel dentatis, dentibus acutis. Venis distinctis, sæpe nigricantibus; soris costularibus, vix 1 mm. longis, indusiis semi-ovatis, rufo-brunneis, integris vel leviter laceratis.

Kinabalu: Kamborangah, near river in forest (H. 25530, type in Herb. C. Chr.), Silau basin (Cl. 29045), Falls above Lumu (Cl. 29967 part).—Sarawak: Mt. Murud (Mjoberg). Plate 56.

This is the most finely dissected of all Asiatic *Athyria*, and a very pretty species. I described it some years ago from Dr. Mjoberg's specimen, but now take Mr. Holtum's more complete one as the type. *A. amoenum* has several characters in common with *A. pulcherrimum*, e. g. colour, scales, and sori, but it is much finer cut and of much thinner texture. Costular spines are present, but mostly very short or quite obsolete.

A. silvaticum (Bl.) Milde.—Lobang, a solitary plant on rocks by stream (H. 25562 Cl. 29591). New to Borneo.

A form with short sori and vaulted indusia.

DIPLAZIUM SWARTZ.

In 1908 Copeland, following Milde, transferred to *Athyrium* the Philippine species formerly placed in *Diplazium* (Phil. Journ. Sci. 3C: 285), and in his later papers he has described a considerable number of diplazioid ferns as species of *Athyrium*, thus dropping the whole genus *Diplazium* (see also his paper: The Oriental Genera of Polypodiaceæ, Univ. Cal. Publ. Bot. 16, no. 2. 1929). I agree with him in the opinion that there does not exist a really generic difference between most species hitherto referred to the two genera, but I fear that it is too unnatural to merge the whole mass of species of *Diplazium* in *Athyrium*, because both genera comprise species of very remote relationship. The type-species of *Athyrium* forms, together with a number of related (mostly northern) species, a well-defined group or genus to which *Cystopteris* (*C. fragilis*, *bulbifera* and relatives) should probably be referred. Other species of *Athyrium* (*A. crenatum* and relatives) should be united with *Cystopteris montana* into another group. Most of the other species of *Athyrium* could very naturally be united with most species of *Diplazium* into one genus, for which the latter name should be used. From this genus certain species, which I cannot see how to distinguish from

Asplenium, should be excluded; among these are *D. porphyrorachis* and *D. pallidum*. Being therefore of the opinion that both genera, as arranged in the Index Filicum, are polyphyletic, I prefer to retain that arrangement pending the further study which is necessary to define the various constituent groups.

D. grammitoides Presl—*Asplenium biseriale* Bak. 1894:252, *Diplazium* C. Chr. Index, *Athyrium* Copel. Keys 376.—s.l. (Haviland 1475, Cl. 11011), near Menetendok, on mossy rocks by edge of river (H. 25577), Silau basin, stream bed between rocks (Cl. 29052).

I cannot distinguish Baker's species from the Philippine type, even as a variety.

D. crenato-serratum Bl. forma—Marei Parei ridge (Cl. 10914), Dallas-Tenompok ridge (Cl. 28155).

D. Hosei Christ is a rather typical form of this species, and *D. larutense* Bedd: (syn. *D. confertum* (Bak.) C. Chr.) is a form with close obtuse pinnæ.

D. sp. near *japonicum* (Thbg.) Bedd.—Near Menetendok, in forest near river (H. 25579).

Perhaps this was also collected by Mrs. Clemens and Topping, as specimens of theirs are said by Copeland (Keys 376, under *Athyrium biseriale*) to be intermediate between *D. japonicum* and *D. Petersenii*; this is true also of Holttum's specimen, but it cannot be referred to either of the two species. The sori seem to be exindusiate. I prefer to let it remain unnamed. It comes very near *D. Woodii* Copel.

D. pallidum (Bl.) Moore—Lobang, on rocks by stream (H. 25559).

I should prefer to retain this species in *Asplenium*.

D. poiense C. Chr. n. sp.—Rhizomate spec. typ.? (in spec. Kinabaluensi erecto, crasso, apice paleis castaneis, nitidis, anguste lanceolatis, in pilum longum desinentibus, integris dense obtecto). Stipite 30 cm. vel ultra longo, ut rachi atro-brunneo, opaco, supra basin sparse paleaceo. Lamina late lanceolata, ad 60 cm. longa, 25 cm. supra basin lata, firmiter herbacea vel papyracea, superne gramineo-viridi, glabra, inferne pallida, ad costas squamulis brunneis sparse prædita, bipinnatifida, versus apicem pinnatifidum sensim attenuata, versus basin vix angustata. Pinnis ad 20-jugis, alternis, 3 cm. inter se remotis, breve petiolulatis, subhorizontalibus, longe acuminatis, ad 15 cm. longis, 2–2.5 cm. latis, basi et medio eximie inæquilateralibus (latere acroscopico medio 1.5 cm. lato, basiscopico medio 1 cm. lato et versus basin valde reducto), e medio versus apicem æquilateralibus, ad alam 5 mm. latam pinnatifidis.

Segmentis oblongis, plerisque falcatis, obtusis, 4 mm. latis, obtuse serratis, sinus angustis separatis, basilibus basiscopis valde reductis. Venis simplicibus, remotis, valde obliquis, non prominentibus, in segmentis majoribus 5-6-jugis. Soris in lobis ca. 1 mm. a nervo mediano remotis et marginem fere attingentibus, parte costali pinnarum fere 1 cm. lata indivisa sterili. Indusiis brunneis, integris, nonnullis diplazioideis, margine exteriori revoluti striam elevatam ad superficiem relinquentes.

SARAWAK: foot of Mt. Poi (Mjöberg, type in Herb. C. Chr.). Kinabalu: Tenompok (H. 25380, Cl. 28412, 29275).

A most distinct species, easily recognised by the unequal-sided pinnæ, the upper side of which is much broader in the lower half than the basiscopic one, and by the sori being placed far from the costa and midrib of the lobes, confined to the marginal half of the lobes. The recurved indusia leave at their outer edge an elevated rim similar to that found in *Asplenium scolopendroides*. This rim is not so evident in Holttum's specimen, which is otherwise very like the type except for the stipe and rachis being lighter in colour. The rim is distinct in the Clemens specimens, which are also larger, with pinnæ to 20 cm. long and 3.5 cm. wide.

Related to *D. poiense* is **D. falcinellum** C. Chr. nom. nov. (*Asplenium matangense* Hose, Jour. Str. Br. R. Asiatic Soc. no. 32: 58. 1899), a species that has been overlooked by almost all writers. It was re-collected by Dr. Matthew on Mt. Matang, Sarawak, in 1912. Dr. Matthew believed it to be my *D. matangense* Index Suppl. 27 (1913), which however is another name for *Athyrium carnosum* Copel., a quite different species. Matthew's fine specimens at Kew show a close resemblance to *D. poiense* in colour and in the shape of the pinnules, but the fronds are bipinnate-pinnatifid; the lower pinnæ resemble strikingly a whole smaller frond of *D. poiense*, the upper ones (and all pinnæ of smaller fronds) have subentire, auricled, falcate pinnules. Further, the species differs from *D. poiense* in its thinner fronds without scales above the base of the stipes, and in the scales of the rhizome, which are light red-brown and broader.

D. Christii C. Chr.—Gurulau spur (Cl. 10860).

Named by Copeland, probably correctly. Scales very few, lanceolate, brown, entire.

D. tricholepis C. Chr. n. sp. *D. Christii* magnitudine, divisione, figura laciniarum, textura sorisque valde similis, ab ea differt: stipite, rachi et costis infra paleis

filiformibus, brunneis, ciliato-dentatis (dentibus pallidis) sat dense vestitis, pinnis infimis multo abbreviatis.

KINABALU: Kamborangah, near small streams in forest (H. 25522, type in Herb. C. Chr.), falls above Lumu, in gorge (Cl. 29579). Plate 57.

Stipe 25 cm. long with many lanceolate brown minutely ciliate scales at base. Lamina broadly lanceolate, 70 cm. long, 25 cm. wide, bipinnatifid. Pinnæ sessile, truncate at base, acuminate, incised to a wing 2 mm. broad, the segments patent, triangular-oblong, 6-7 mm. wide at base, those of the lower side usually somewhat longer than the upper ones (1.4 against 1.2 cm.), obtuse and toothed in the outer half or occasionally acute on the lower pinnæ. Veins dark, 6-7-jugate, forked or simple; sori narrow, straight, extending from the costa nearly to the edge, the acroscopic basal one diplazioid.

The description here given fits *D. Christii* equally well, except that the scales are very different.

D. speciosum Bl.—Tenompok to Lumu Lumu, terrestrial in forest (H. 25444).

A widely-spread species which I united with *D. sorso-gonense* Pr. in my Index, probably wrongly. The specimen quoted agrees excellently with another in my herbarium from Java which I have noted as typical. It is larger than the two former species, subcoriaceous, much deeper incised, sub-bipinnate, the pinnules or segments spaced, oblong, subacute, 15-18 mm. long by 5 mm. wide, serrate nearly from the base. The scales are very few, linear.

D. lævipes C. Chr. n. sp.—Rhizomate breve repente, radicibus crassis nigris multis vestito; stipitibus fasciculatis. Stipite ad 55 cm. longo brunneo, lævi glabroque, basi sparse paleaceo sursum subnudo (paleis brunneis, integris, basi peltatis, mox deciduis hinc inde præditis). Lamina ovata, ca. 70 cm. longa, supra basin 35 cm. lata, tenuiter papyracea, infra (sicca) brunnea, glaberrima nudaque, basi bipinnata sursum bipinnatifida, rachi 10 cm. infra apicem superne gemmifera. Pinnis subalternis; inferioribus 8 cm. inter se remotis, petiolatis (petiolo 2 cm. longo); iis secundi paris maximis, ad 25 cm. longis, medio 8 cm. latis (infimis paulo brevioribus), breve acuminatis, versus basin angustatis et pinnatis (pinnulis liberis 1-3-jugis, adnatis), sursum profunde pinnatifidis, segmentis medialibus maximis, ca. 4-5 cm. longis, 1-1.2 cm. latis, acutis, serratis; pinnis superioribus sessilibus, pinnatifidis, segmentis ca. 2 cm. longis, 7 mm. latis, subcontiguis, oblongis, obliquis, versus apicem postice rotundatum antice subacutum dentatis, basalibus acroscopicis multo reductis.

Venis in segmentis majoribus pinnatis, in minoribus e medio furcatis (ramis confertis) vel simplicibus. Soris angustis e costula vix ultra medium segmenti extensis, multis diplazioideis; indusiis perangustis, cito evanidis.

KINABALU: near Dallas, terrestrial in forest (H. 25259, type in Herb. C. Chr.), Kiau (Tp. 1537). Plate 58.

Closely related to *D. spiniferum* v. A. v. R. Handb. Suppl. 265 (*Athyrium muricatum* Copel.) from Sarawak and Dutch Borneo (Hallier 3227), to which Copeland referred Topping 1537. That species is quite similar in size, colour and division, but the stipe is prickly, the segments all entire, the sori far from the costule, and the frond coriaceous. *Athyrium carnosum* Copel. is another near ally with thick, nearly carnose fronds.

D. barbatum C. Chr. n. sp.—Rhizomate breve erecto, stipitibus fasciculatis. Stipite ad 30 cm. longo, brunneo, sulcato, ubique cum rachi densissime squamoso; squamis plus minusve squarrosis, lanceolatis vel linearibus, inferioribus maximis, in apicem piliformem minute dentatum longissime acuminatis, brunneis, concoloribus. Lamina late lanceolata, ad 65 cm. longa, 30 cm. lata, obscure viridi, papyracea, bipinnata vel folii minoris bipinnatifida, rachi ut stipite squamis (parvioribus) barbata. Pinnis folii majoris alternis, sessilibus, 8 cm. inter se remotis, maximis 15 cm. longis, 5 cm. latis, infimis paulo abbreviatis, basi aequaliter truncatis, breve acuminatis, fere omnibus infra apicem pinnatifidum pinnatis; pinnulis liberis ca. 10-jugis, alternis, patentibus, ad 2.5 cm. longis, 1 cm. latis, basi late ad costam adnatis, apice acutis vel rotundatis, plus minusve profunde crenulato-serrulatis, apicem versus sæpe leviter dilatatis; costis costulisque inferne ut rachi dense barbatis, superne sparse fibrillosis. Venis prope basin furcatis, ramo basiscopico sæpissime iterum furcato vel subpinnato, acroscopico solum sorifero. Soris angustis, e costula fere ad marginem extensis, obliquis et sæpe curvatis, infimis diplazioideis; indusiis brunneis, integris.

Adest etiam planta minor, foliis bipinnatifidis, pinnis 9×2.5 cm., profunde pinnatifidis, segmentis 5–6 mm. latis, sub apicem rotundato-obtusum leviter dentatum integris.

KINABALU: Tenompok, terrestrial in forest (H. 25386, type in Herb. C. Chr.; Cl. 29413). Plate 59.

Somewhat resembling *D. speciosum* in general habit, colour and texture, but very distinct by its densely squamose stipe, rachis and costæ. The smaller bipinnatifid fronds may easily be confused with *D. tricholepis* (described

above), but the shape of the segments is different; in *D. barbatum* they are of equal width from base to tip, or not rarely broadest above the middle, never triangular-oblong.

D. Hewittii (Copel.) C. Chr. Index Suppl. 26. 1913. *Athyrium* Copel. Phil. Journ. Sci. 7c: 62. 1912.—Marei Parei ridge, terrestrial in low ridge forest (H. 25616).

A small leaf, which I think may be referred here, as it agrees well with the type from Mt. Matang in its rigid texture, in the degree of division, and in the costular short sori; but the pinnules are at best 2 cm. long and 5–6 mm. wide. (A larger frond, in the Singapore herbarium, has pinnules to 5.5 by 1.5 cm.). A beautiful series of specimens collected by Mjöberg in Sarawak has shown that *A. Hewittii*, *A. sarawakense*, and *A. paripinnatum* of Copeland are probably all forms of the same species, different in size, but otherwise scarcely distinguishable.

D. vestitum Pr. var. **borneense** n. var.—A typo Philippinensi differt: fronde crasse coriacea, rachi costisque subnudis, paleis perpaucis, parvis, marginibus nigris, dentatis.

Path to Dallas, wet ground by stream (H. 25134), Tenompok (Cl. 28690, 27734, 27478), Kounng to Kabayau (Cl. 27676). Also: Bettotan near Sandakan (Boden Kloss 19049), Rian (Burbidge).

These specimens are quite identical, and I am rather in doubt whether they should be referred either to *D. vestitum* or to *D. crinitum* (Bak.) C. Chr. They agree best with the former in general appearance, (cf. Hook. Sec. Cent. pl. 46), though the pinnules are short-acuminate. The strong stipe is rather scaly, but the scales soon fall, leaving the bases as short soft spines. The scales, like those of *D. crinitum*, are bordered with an ebeneous, sharply toothed edge. I have not observed such scales in the old specimens of *D. vestitum*, but they should be sought for in fresh specimens. The scales of the axes of *D. crinitum* are stalked and very peculiar (cf. Copeland, Brittonia 1: 73. 1931).

D. dilatatum Bl.—*D. maximum* C. Chr. Index p.p., *Athyrium* Copel. Keys 378.—Lobang (Tp. 1784, H. 25555), Tenompok (Cl. 29419).

The nomenclature of the large bipinnate species of *Diplazium* is very confused, and it seems to me better to use Blume's certain name rather than Don's two doubtful ones, *maximum* and *latifolium*, which must be applied to Himalayan forms. No. 25555 agrees excellently with a cotype specimen of *D. dilatatum* at Kew. The stipe is not spiny. The status and nomenclature of the many species or forms allied to *D. polypodioides* cannot be defined until the whole group is revised.

D. polypodioides Bl.—Gurulau spur (Gibbs 4,000). Not seen.

D. asperum Bl.—Koung to Kabayau, on bank by bridle path, locally abundant (H. 25630), Tenompok (Cl. 28080).

D. atosquamosum (Copel.) C. Chr. comb. nov. *Athyrium atosquamosum* Copel. Phil. Journ. Sci. 12c: 59. 1917.—Marei Parei ridge (Cl. 11051), Tenompok to Lumu Lumu, terrestrial in forest, frequent (H. 25429), Tenompok (Cl. 27122, 28410, 28286, 28103), Lumu trail (Cl. 28391), above Kamborangah (Cl. 27951), falls above Lumu (Cl. 29716, young plant).

Very near *D. polypodioides* Bl. (*Athyrium Blumei* Copel.), but firmer in texture, the stipe slightly asperous below, not spiny, and the sori costular, very short. Holttum's specimens are no doubt this species, although the basal scales on stipes are brown, not black as in the type. The scales on an unexpanded frond are black.

D. tabacinum Copel. Phil. Journ. Sci. 1 Suppl. 149, pl. 6. 1906. *Athyrium* Copel. l.c. 3c: 292. 1908.—Near Lobang, in forest near river (H. 25565), Dallas-Tenompok ridge (Cl. 26818).

Very like *D. cordifolium* var. *pariens*, but dark coloured, all pinnæ rounded-cuneate at base and sessile, no buds on the rachis, and the veins mostly free, though frequently united just within the margin.

D. cordifolium Bl.—Near Dallas, frequent in forest (H. 25140, Cl. 27385, 26898), above Lumu (Cl. 27062).

var. *pariens* (Copel.). *Athyrium pariens* Copel. Phil. Journ. Sci. 3c: 299. 1908. Keys 380.—Gurulau spur (Tp. 1631), near Dallas, on ground in forest (H. 25139, Cl. 27433), Tenompok (Cl. 29422, 26950, 27502), above Lumu, on rocks (Cl. 27066).

Several intermediate specimens have convinced me that this is a form of *D. cordifolium* with 7–8 pairs of pinnæ and with buds in the axils of the upper ones.

There is also a small plant with a few close lateral pinnæ (Dallas-Tenompok ridge, Cl. 28338).

D. bantamense Bl. var. *alternifolium* (Bl.) v. A. v. R. Handb. 406.—Tenompok (Cl. 27195, 29406).

These specimens match very well some from the New Hebrides (Heras 82) named thus by Kuhn, but I am not sure of the identification. They differ from *D. bantamense* in the greater number of pinnæ, which are up to 30 cm. long by 5 cm. wide, subcuneate or rounded or even truncate at the base, coarsely serrate towards the long-acuminate apex. Scaly buds are borne in the axils of the upper pinnæ.

D. fraxinifolium Presl var. *grossum* (Pr.). *Anisogonium*

grossum Pr., Epim. Bot. 93. 1851.—Near Dallas, terrestrial in forest (H. 25258), Tenompok (Cl. 29438, 26855, 27733).

Holtum's specimen matches exactly the Kew specimen of Cuming's no. 305, from Leyte, the type-number of Presl's species, which has never been described. Pinnæ 6 pairs below a terminal one, up to 33 cm. long by 6 cm. wide, entire or undulate-repand, serrate toward the suddenly acuminate apex, pale green, thin, the basal ones very shortly stipitate, the upper adnate to the rachis. Veins sparsely anastomosing near the margin, not rarely free. *D. xiphophyllum* (Bak.) C. Chr. from Labuan (Burbidge), to which I refer *D. palauanense* Copel., is, I think, just the same, with all veins free. It has been collected also in Pahang at Ulu Chineras (Burkill, Herb. Singapore 15692).

DIPLAZIOPSIS C. CHR.

- D. javanica** (Bl.) C. Chr.—Near Menetendok, on rocky stream bank, in shade (H. 25581), Silau basin, on rock by stream at 7,000 ft. (Cl. 29036) New to Borneo.

ASPLENIUM LINN.

- A. nidus** L.—Tenompok (Cl. 28725, 28577).
 var. *ellipticum* (Fée) ?—Lobang (Cl. 10324).
 var. *phyllitidis* (Don)—Dallas, East ravine (Cl. 27304).
A. batuense v. A. v. R. Bull. Dép. Agr. Ind. Néerl. XVIII: 13. 1908; Handb. 443; Bull. Jard. bot. Buit. III ser. 2: 132. 1920.—*A. Brooksii* Copel. Phil. Journ. Sci. 6C: 137. 1911.—*A. Grashoffii* Rosenst. Fedde Repert 13: 215. 1914. Distribution: Sarawak, Batu Islands, Sumatra, Malay Peninsula.

forma angusta ?—Leaves 3–3.5 cm. wide only. *A. concolor* Copel. Keys 383.—Kiau to Lobang (Tp. 1593).

I have seen the types of the three species quoted above, and find no essential difference between them. I am more in doubt about the right name for the Kinabalu fern, but I believe it is referable to the present species. It is certainly not *A. concolor* Hk., as believed by Copeland; *A. concolor* is furnished with small lacerate scales beneath.

- A. scolopendrioides** J. Sm.—*A. glochidiatum* Racib. (t. sp. orig.)—Tenompok, on bases of trees in forest (H. 25383, Cl. 26830, 27193, 28457, 27477), Dallas, East ravine (Cl. 27373).

Known previously from the Philippines (Cuming 318, type!) and Borneo, recently collected in the Anamba Islands (Henderson, Herb. Singapore 20198) and Pulau Tioman,

Pahang (Henderson 18763); it has once been collected on the mainland of the Malay Peninsula, near Raub, Pahang (Best 14166).

Young plants of this species first bear leaves deeply lobed to a narrow wing, the lobes narrow and distant; on a leaf 5 cm. long there are 4 lobes on each side, the lobes about 2 mm. wide. Older plants have the wing progressively wider and the lobes shorter and closer.

A. squamulatum Bl.—Koung, on rocks in shade (H. 25122), Dallas (Cl. 27309, 27231).

A. natunae Baker, from the Natuna Islands (Hose 321) is to me a rather typical form of this species.

A. trifoliatum Copel. Phil. Journ. Sci. 5c: 284. 1910.—*A. prolificans* v. A. v. R. Bull. Jard. Bot. Buitenz. II ser. XI: 4. 1913.—Kiau to Lobang (Tp. 1604), Tenompok (Cl. 29429), Dallas (Cl. 26818 bis).

Pinnæ more numerous (5 pairs) and smaller than in Sarawak specimens, but certainly the same species. A beautiful series from Mt. Merinjak, Sarawak (Nat. Coll.) show simple fronds with lamina 70 by 11 cm., and pinnate ones with 1-2-3-4 pairs of pinnæ below the large terminal proliferous one.

A. filiceps Copel. Phil. Journ. Sci. 5c: 285. 1910.—*A. cuspidifolium* v. A. v. R. Bull. Jard. bot. Buitenz. II ser. XX: 7. 1915.—Below Dallas, on rock by stream, pendulous (H. 25360), below Kabayau (Cl. 27688 simple and pinnate).

Evidently this is a common species in Borneo, where it has often been collected. It occurs also in the Malay Peninsula, having been found in Pahang, S. Sat (Henderson, Herb. Singapore 22080).

Copeland described *A. filiceps* after specimens from Tringos, Sarawak (Brooks 21!) with simple fronds, but it is certain that this species, like many others of this group, may bear both simple and pinnate fronds, often on the same rhizome; this condition is found in a beautiful series of specimens from Mt. Merinjak, Sarawak (Native Coll. Sarawak Mus. 139, 156). In the Pahang specimen quoted above, the number of pinnæ varies from one to several pairs. In Holtum's Kinabalu specimen there are 8 pairs of lateral pinnæ, and this number also is quoted for *A. cuspidifolium*. The species is certainly closely related to *A. vulcanicum* Bl., and the two are often united. *A. filiceps* however seems to me sufficiently different in its usually thinner texture, the pinnæ very long-cuspidate at the apex and rounded-cuneate or even truncate at the base, not long-cuneate. It is more difficult to see how the smallest forms may be distinguished from *A. salignum* Bl.

A. pachychlamys C. Chr. n. sp.—Rhizomato breve repente, paleis clathratis, atro-brunneis, lanceolatis, ad 1.5 cm. longis, integris, dense vestito. Stipite 30 cm. vel ultra longo, brunneo, opaco, ut tota planta glaberrimo, juvenili sat dense paleaceo, paleis parvis angustis basin versus ciliatis cito delapsis. Lamina pinnata cum impari, coriacea, subtus pallida, ad 50 cm. longa; rachi colore stipitis, superne applanata vel latissime sulcata; pinnis ca. 9-jugis, suboppositis, 5 cm. inter se remotis, adscendentibus, breve petiolulatis, linearibus, usque ad 25 cm. longis et 1 cm. latis, versus basin longe et inequaliter cuneatis, versus apicem longe et gradatim attenuatis, marginibus levissime et remote dentatis, pinna terminali simili. Venis indistinctis, valde obliquis, simplicibus, fere omnibus soriferis; soris e costa fere ad marginem extensis; indusiis pallidis, crassis, integerrimis, 1 mm. vel ultra latis, ad superficiem pinnæ appressis, sæpe contiguis.

KINABALU: Tenompok, epiphytic on tall tree (H. 25355, type in Herb. C. Chr.); also Tenompok (Cl. 29228, 28027, 26983), Pakka (Cl. 27963).

This is a most distinct and peculiar species, quite different from all others by its long narrow coriaceous and glabrous pinnæ, and especially by its remarkably broad, thick indusia, which are pressed over and entirely conceal the sporangia.

A. horizontale Baker.—Tenompok, in forest (Cl. 29266).

The specimen agrees closely with the type from Sumatra (Hancock 59, Kew) in size, shape, colour, texture and horizontal position of the pinnæ, which however are more numerous (up to 11 pairs), truncate or the lower ones subcordate, and short-stalked, not cordate and overlapping the rachis; they are also practically glabrous (without scales).

A. tenerum Forst.—Kamborangah, epiphyte on mossy tree by river (H. 25537), falls above Lumu (Cl. 29970), Tenompok (Cl. 28361, 29549), Silau basin at 7,000 ft., on rock by stream (Cl. 29091). These are the common Malayan form with acuminate pinnæ and often bud-bearing rachis.

var. **retusum** C. Chr. var. nov. The apical teeth are very small, and the terminal one often entirely missing; the pinnæ therefore have truncate or even retuse tips, and are about of the same width from base to apex. The plant looks in habit quite different from the form with acuminate pinnæ, but agrees with it in all important characters. Near Menetendok, on rocks by stream (H. 25586), Dallas—Tenompok spur (Cl. 27746).

This variety is very common in the Malay Peninsula, and in the south at least is probably more common than the typical form. Somewhat intermediate specimens also occur. (R. E. H.).

A. Klossii C. Chr. n. sp. Rhizomate breviter repente vel adscendente, paleis fuscis, ovato-acuminatis, subpeltatis, integris vel sub apice sparse dentatis vestito. Stipitibus fasciculatis, ut rachi griseoviridibus, glabris, supra leviter trisulcatis et paleis minutes obsitis, inferne teretibus nudisque, 15–20 cm. longis. Lamina late lanceolata, ad 35 cm. longa, 15 cm. lata, coriacea, pallide viridi, pinnata, in apicem vel pinnam terminalem caudatam, lobatam, subito contracta. Pinnis 12–13-jugis, horizontalibus, suboppositis, 2.5 cm. inter se remotis, sessilibus (vel inferioribus brevissime petiolulatis), basi cordatis, acutis, maximis 7 cm. longis, 10–15 mm. latis, levissime serrulato-undulatis, infimis vix brevioribus, interdum reflexis, rachi sursum distincte alata, pagina inferiore pinnarum paleis minutis, clathratis, basi stellatim fissis, cuspidatis conspersis. Venis simplicibus, obliques, parallelis; soris a costa fere ad marginem productis, indusiis pallidis, integerrimis.

BRITISH NORTH BORNEO: Bettotan near Sandakan (Boden Kloss 18993). Plate 60.

I know only two species with similar cordate pinnae, namely the Javanese *A. diversifolium* Bl., and *A. horizontale* Bak., both of which differ from *A. Klossii* by their smaller number of pinnae and by the end-pinna being like the lateral ones or larger. In *A. Klossii* the terminal pinna is much smaller, deeply lobed or even pinnate below, and prolonged above into a long, nearly thread-like, caudate tip, much as in the variety or subspecies of *A. tenerum* described as *A. productum* Pr. *A. Klossii* also agrees with *A. tenerum* in its rachis being winged above.

A. Belangeri (Bory) Kze.—Dallas (Cl. 30378).

A. normale Don—Gurulau spur (Cl. 10854), Tenompok, common on ground in forest (H. 25423, Cl. 28546, 27192, 27425, 28879, 28165, 29489, 29056), ravine above Dallas (Cl. 26890).

A. borneense Hook.—s.l. (Haviland 1477), Marei Parei ridge (Cl. 10946), below Dallas, on wet shady rocks by stream (H. 25365), Tenompok (Cl. 28364). This species has now been collected also in Sumatra and Perak.

A. unilaterale Lam.—Falls above Lumu (Cl. 29969).

A. filipes Copel. Phil. Journ. Sci. 3c: 34. 1908.—Near Dalls (H. 25146, Cl. 27292, 26894).

This species grows on wet rocks by waterfalls. It is one of the many small-sized subspecies or varieties of *A. unilaterale* Lam. Holttum's specimen agrees with the typical Philippine form, only differing a little in its light red-brown stipe and rachis. New to Borneo.

A. subnormale Copel. in Perk. Frag. 184. 1905.—Dallas, East ravine, rock crevices above river (Cl. 27298).

A. lobangense C. Chr. n. sp. e grege *A. macrophylli* Sw. Rhizomate breve, paleis nigris, lanceolatis, integris onusto. Stipitibus paucis, approximatis, strictis, ad 30 cm. longis, griseo-viridibus vel brunnescentibus, squamulis parvis, ovatis, brunneis, pellucidis (cellulis sat magnis), sparse lacerato-fimbriatis cum rachi sat dense paleaceis. Lamina lanceolata, ca. 30–40 cm. longa, 10–16 cm. lata, papyracea vel firmiter herbacea, colore brunnescente, pinnata, apice gemmam squamulosam nascente. Pinnis ca 12-jugis, alternis, 3.5 cm. inter se remotis, breve (2–3 mm.) petiolulatis, maximis 9 cm. longis, 1.5 cm. latis, infimis vix reductis, basi postice breve cuneatis antice truncatis, non auriculatis, acutis vel breve acuminatis, marginibus integris vel indistincte et remote dentatis, superne glaberrimis, inferne squamulis minimis laceratis brunneis conspersis. Venis 9–10-jugis, valde obliquis, plerisque bis furcatis, distinctis. Soris remotis, secus ramos acroscopicos venarum fere a costa ad marginem productis, ergo valde obliquis et sæpe arcuatis, indusiis læte brunneis, integerrimis.

KINABALU: near Lobang, terrestrial, on steep rocky slope in forest (H. 25548, type in Herb. C. Chr.).

This new species somewhat resembles *A. paradoxum* Bl., but is quite different by its much smaller pinnæ, remote sori and scaly stipe and rachis. It is more closely related to *A. Sancti Christophori* Christ (syn. *A. Gjellerupii* v. A. v. R.) from New Guinea, which is nearly the same and shows the same essential characters, but its pinnæ are much shorter and broader at their base, being trapezoideo-triangular in outline, and more distinctly dentate.

The leaf of *A. lobangense* seems always to terminate in a scaly bud; this bud is sometimes sessile and apparently lateral at the base of a terminal pinna, sometimes stalked and apparently terminal.

A. porphyrorachis Baker Journ. Bot. 1879: 40. Ic Plant. 1650. *Diplazium* Diels, C. Chr. Index; *Athyrium* Copel. Keys 379.—*Polypodium subserratum* Hook. 1862 (not *Asplenium subserratum* Bl. 1828).—Tenompok, edge of forest, on ground (H. 25379, Cl. 29437, 28238).

This species, which is common in Borneo, is extremely near the following, chiefly differing in being pinnatifid only, and by the segments being fertile from base to tip with the basal sori occasionally diplazioid. Retaining *A. fuliginosum* in *Asplenium*, it is unnatural to place this species in *Diplazium*; further, *A. porphyrorachis* is in many characters very near *A. pellucidum*, *A. longissimum* and other allied species. *Athyrium Merrillii* Copel. from Mindoro and Papua is hardly different.

A. fuliginosum Hook.—Marei Parei spur at 7,000 ft. (Gibbs 3109, *Trichomanes javanicum* Gepp), Near Kamborangah, on rocks near river (H. 25529), s.l. (Low), Silau basin at 7,000 ft. by forest stream (Cl. 29749).

Holttum's specimens match the type perfectly (see Hook. Sec. Cent. pl. 3). This is larger than the former species (the leaf 80 by 12 cm.), fully pinnate in the lower two-thirds, the pinnæ acuminate, fertile in the outer half only; scales, dark colour and texture as in *A. porphyrorachis*.

A. adiantoides (L.) C. Chr.—*A. falcatum* Lam., Copel. Keys 384.—Kiau (Tp. 1571).

A. nigrescens Bl. v. A. v. R. Bull. Jard. bot. Buitenz. II ser. no. I: 3, pl. 1 f. 4.—Marei Parei ridge, epiphyte (H. 25615), falls above Lumu (Cl. 29972).—Sarawak: Mt. Murud (Mjöberg.).

Holttum's specimen is identified by comparison with the illustration quoted, and with specimens named by Copeland. Copeland considers *A. nigrescens* doubtfully different from *A. contiguum* Klf., but in this I do not agree. Our plant is much larger than the genuine *A. contiguum* from Hawaii, and the sori not nearly so close and parallel to the costa. I am not at all sure that the true *A. contiguum* occurs in Malaya.

A. acutiusculum Bl.—Lobang to Kiau (Tp. 1814), Tenompok, on trees and rocks by stream (H. 25402, Cl. 26646, 28054, 26829), Dallas-Tenompok ridge (Cl. 27604, 26889), Bundu Tuhan (Cl. 28052).

The lower pinnæ of most fronds have a large free auricle at the upper base, and the rachis is usually bulbiferous near the apex.

A. planicaule Wall. ? —Lobang (Tp. 1773), Dallas-Tenompok and Silau basin (Cl., both s. n.).

Copeland named Toppings's specimen *A. falcatum* var., but it can hardly belong to that species. It is small, with pinnæ not more than 2 to 2.5 cm. long and rather deeply lobed.

A. malayo-alpinum Holttum n. sp.—Rhizomate tenue longe repente, paleis dense vestito; paleis purpureo-brunneis,

tenuibus, ca. 6 mm. longis, basi haud 1 mm. latis, apice acuminatis filiformibus, non dentatis. Stipitibus inter se haud 1 cm. remotis, tenuibus, pluribus ca. 12 cm. longis, maximis 25 cm., fuscis, basin versus paleis ut rhizomate vestitis. Lamina 8-16 cm. longa, 3-5 cm. lata; in sicco fusca; pinnis omnibus oblique adscendentibus, ca. 6-8-jugis infra apicem pinnatifidam; pinnis infimis 2-3-jugis subæqualibus, oppositis vel alternis, ad 4.5 cm. longis, 1.5 cm. latis, basi postice anguste antice late cuneatis, basin versus pinnatis, pinnulis liberis 1-3-jugis; apicem versus angustatis lobatis, lobis angustis apice anguste dentatis; pinnula basale acroscopica maxima, anguste elliptica vel anguste obovata, apice rotundata anguste dentata; pinnulis ceteris multo angustioribus; textura tenuiter coriacea, marginibus pinnarum in sicco involutis; rachi costisque inferne paleis parvis angustis ut rhizomate munitis. Soris 2 in segmentibus basalibus acroscopicis, in segmentis ceteris solitariis; soris distalibus longis subparallelis, maturis paginam totam tegentibus.

KINABALU: at 12,500 ft, in crevice of overhanging rock (H. 25485, type in Herb. Singapore), Pakka to Low's Peak (Tp. 1697, Cl. 10647). Plate 61.

LUZON: Mt. Pulog, Benguet, 2,400 m, Pterid. Philip. Exsic. 170, distributed as *A. cuneatum*. Celebes: Bonthain Peak, 10,000 ft. (Everett 85, in Herb. Singapore). Java: G. Pangerango (in Herb. Bog. as *A. praemorsum*).

This species is quite different from *A. cuneatum* (a West Indian species) and its allies, but is closely related to *A. praemorsum* Sw., from which it differs by its creeping rhizome covered with thin castaneous lanceolate finely acuminate entire, not clathrate, scales. Several very similar species occur in Africa. *A. malayo-alpinum* is closely related to a species described from Perak (*A. perakense* Matt. and Chr., Journ. Linn. Soc. Bot. 39: 214. 1909), but is distinct in its long-creeping rhizome, densely covered with scales, its relatively few pinnæ which are obliquely ascending, the lowest not deflexed, in the shape of the lowest acroscopic pinnules, and in the finely toothed pinna-lobes. *A. perakense* was found in forest at much lower altitudes than the 10,000 feet level at which *A. malayo-alpinum* occurs. The specimens from the various mountains quoted are closely similar. The very closely placed rhizome scales make the rhizome appear much larger than it really is; its actual diameter is 2 mm., and the scaly covering increases this to 8 mm.

A. kinabaluense Holttum n. sp.—*A. malayo-alpino* similis, differt: paleis latioribus apice non filiformibus, frondibus triangularis, pinnis infimis maximis, latioribus,

profunde dissectis, pinnis sub-basalibus haud adscendentibus, pinnulis basalibus acroscopicis late cuneatis profunde lobatis, costis inferne paleis latis munitis.

Rhizome slender long-creeping, clothed with castaneous scales; the scales thin, about 1.5 mm. wide at the base, narrowed to an acute but not filiform apex, to 6 mm. long; stipes slender, dark brown, at the base scaly like the rhizome, about 8 to 14 cm. long; lamina narrowly deltoid, to about 14 cm. long and 7 cm. wide, the lowest pinnæ largest, slightly ascending, upper pinnæ usually nearly horizontal; lowest pinnæ about 4–5 cm. long and 2.5 cm. wide, deltoid, dissected into separate pinnules almost to the apex, the lowest pinnules broadly cuneate and dissected almost to the costa into several lobes, the lobes subentire or shortly incised into a few teeth; the upper pinnæ progressively smaller and less dissected; texture thinly coriaceous; colour dark; rachis and costæ beneath rather copiously provided with scales similar to those on the rhizome but smaller (*i.e.*, relatively broad thin scales, not hair-pointed); sori long, several on each pinnule, when mature almost covering the lower surface.

KINABALU: base of Victoria Peak, 13,000 ft. (Cl. 29830, type in Herb. Singapore). Plate 62.

This species is clearly distinct from *A. malayo-alpinum* in the points mentioned in the Latin diagnosis. Its rhizome is less thickly clothed with scales, and so appears more slender (about 4 mm. including the scaly covering); the scales are quite different in shape, and the frond is a different shape and more deeply dissected. The fronds are more like those of *A. Elmeri*, but from this species it is clearly distinguished by the long-creeping rhizome, and by the broad scales on the under side of rachis and costæ.

A. spathulinum J. Sm., C. Chr. Gard. Bull. S. S. 4: 400. 1929.—*A. affine* p.p. auctt., Copel. Keys 385.—Below Dallas, on rocks by stream (H. 25364, Cl. 28038, 26924), Tenompok (Cl. 27769, 28689, 29418).

This has usually spathulate-cuneate pinnules which in larger leaves may be more or less incised.

var. **amaurolobum** Rosenstock in Herb. (pro specie).—Menetendok, on rocks and trees by stream (H. 25582).

The pinnules are roundish obtuse, slightly or not at all incised, at the base cuneate on the inner side, parallel to the costa and obtusely subauriculate on the outer one. The extreme forms of this variety look rather different from the type, but intermediate forms occur; thus the larger leaf of no. 25364 is very typical, but the smaller one is more like the variety, which has been found in several places in Borneo.

- A. **Elmeri** Christ—*A. laserpitiifolium* Bak. 1894: 252.—s.l. (Haviland), Pakka cave, on trees near stream (Tp. 1677, H. 25502), Tenompok (Cl. 28641), below Pakka, on ridge (Cl. 27964, 27057), Silau basin at 7,000–8,000 ft. (Cl. 29711), Low's Peak (Cl. 27046).
- A. **dichotomum** Hook.—s.l. (Low, Burbidge, Haviland 1494), Kiau to Lobang (Tp. 1598), Lobang, on rock in forest (H. 25551), Dallas-Tenompok ridge, on rock by waterfall (Cl. 27737), Silau basin at 5,000 ft. (Cl. 29305).

BLECHNUM LINN.

The four or five species of the subgenus *Lomaria* found on Kinabalu are an interesting instance of an Australian element in the Malayan flora.

- B. **fluviatile** (R. Br.) Lowe—Kamborangah to Pakka, 9,000 ft. (Cl. 28727), above Pakka, under great slanting rock, 12,000 ft. (Cl. 27044), Low's Peak, between rocks (Cl. 27047).

A most interesting and unexpected find in Malaysia of a species hitherto known only from the southern temperate region (Australia, Tasmania and New Zealand). The Kinabalu specimens agree closely with the common New Zealand form in division, scaly stipes and rachis, short and broadly obtuse sterile pinnæ, and in the narrow fertile frond with ascending short pinnæ. Some plants match exactly the figure of *Lomaria rotundifolia* Raoul, Choix de Plantes Nouv. Zel. pl. 2B. The specimens are perhaps smaller than the average size of the species (those from the summit are particularly dwarfed), and of a harsher texture, probably due to the exposed localities of high altitude.

- B. **Patersonii** (R. Br.) Mett.—Lobang (Cl. 10352), near Kamborangah, on rocks by river (H. 25528), Silau basin, rocks in river bed (Cl. 29031).

In shape and cutting typical, but pinnæ numerous (up to 12 pairs), the sterile ones up to 20 cm. long by 2.5 cm. wide, the fertile 12 cm. by 4 mm.

- B. **procerum** (Forst.) Sw.—*B. capense* p. p. auctt., Index.—Marei Parei spur (Cl. 11055).

I am now sure that this Australian-Malayan species cannot properly be united with the South African *B. capense* (L.) Schlecht. Before the whole complex of forms of this group is revised thoroughly I dare not decide if the Kinabalu form and others from Borneo are rightly referred to *B. procerum*, but they are at least closely related to the type. *B. capense* Gepp p. 201 (Gibbs 4309) from the summit of Kinabalu may be this, but is more probably the next species.

B. vestitum (Bl.) Kuhn.—Tenompok to Lumu Lumu, in ridge forest (H. 25443), Kamborangah, low forest (Cl. 28883), s.l. (Cl. 27755).

Much more scaly than the specimen referred to *B. procerum*, but otherwise scarcely different, and it is not improbable that both belong to the same species.

B. Fraseri (Cunn.) Luer. var. **philippinense** Christ, Bull. Herb. Boiss. 6: 149, pl. 2 (sub *Lomaria*)—Marei Parei ridge (Cl. 11032, H. 25612).

A small tree fern with an erect stem nearly 1 m. high, somewhat more robust than the type from New Zealand. *B. Fraseri* var. *novoguineensis* Brause (Engler's Bot. Jahrb. 56: 159, 1920) is to me the same.

B. orientale Linn.—Bridle path to Dallas (H., s.n.), Dallas (Cl. 26477).

This species is exceedingly abundant all along the bridge paths up to 3,000 ft. altitude or more. Cl. 26477 is bipinnatifid.

B. Finlaysonianum Wall.—Tenompok, on high ridge (Cl. 28728, 29492), Kamborangah (H., s.n.).

A forest species, always growing in shade. It is rather common in lowland forest in the south of the Malay Peninsula, but on Kinabalu was nowhere abundant and I only saw it two or three times. Its occurrence at nearly 7,000 ft. altitude is interesting.

PITYROGRAMMA LINK.

P. calomelanos (L.) Link, Hdb. Gew. 3: 20, 1833.—Dallas, thicket above stream (Cl. 27036).

SYNGRAMMA J. SMITH.

S. alismifolia (Pr.) J. Sm.—Marei Parei spur (Tp. 1868).

CONIOGRAMME FEE.

C. fraxinea (Don) Diels, Hieron. Hedwigia 57: 286, 1916.—Near Dallas in forest by stream (H. 25277). Recorded by Copeland, Keys 329, but I have seen no specimen.

A form with only the largest pinnæ pinnate at the base, otherwise simply pinnate with pinnæ 25–30 cm. long by 5 cm. wide and very like the following species, but venation different. The veins end in a clavate straight hydathode which is separated from the entire thin margin by a layer of mesophyll.

C. macrophylla (Bl.) Hieron. l.c. 291, var. **Copelandi** Hieron. l.c. 292.—Near Menetendok, in forest by river (H. 25588), Dallas (Cl. 27227). New to Borneo; the type is from Java, the variety from the Philippines.

Always (?) simply pinnate; the veins end in a thick, somewhat arcuate hydathode which is connected with the broad cartilaginous margin by sclerenchymatous cells; otherwise the species is hardly different from the former.

CHEILANTHES SWARTZ.

- C. tenuifolia* (Burm.) Sw.—Koung to Kabayau, bank of
bridle path (Cl. 27678).

ADIANTUM LINN.

- A. diaphanum* Bl.—Lobang, abundant on rocks by edge of
stream (Cl. 10327, 10358, H. 25553), Dallas-Tenompok,
on bank by path (H. 25290, Cl. 27513), Tenompok (Cl.
26982, 28360), falls above Lumu, in cave (Cl. 29462),
Menetendok gorge (Cl. 29385).

PTERIS LINN.

- P. vittata* L. Hieron. Hedwigia 54: 290. 1914.—*P. longifolia*
auctt. ex parte, Copel. Keys 332.—Lobang (Cl. 10323).
P. rangiferina Pr. var. *scabripes* n. var.—Stipe 50 cm. or
more long, scabrous with numerous small raised points,
especially towards the base. Sterile pinnæ 5 to 8 pairs,
10–15 by 2–3 cm., with a distinct cartilaginous margin,
coriaceous, pale green; fertile pinnæ 1 cm. wide.
Marei Parei ridge (Cl. 11062), Penibukan ridge (H.
25621).
P. Dalhousiæ Hook.—Above Tenom (Gibbs 2878).
Copeland suspected that Gepp had named Gibbs 2878
wrongly, but the specimen in the British Museum is no doubt
a small form of this species.
P. ensiformis Burm.—Kiau (Tp. 1558), below Tenompok
(Cl. 29028), Dallas-Tenompok ridge, bank by path
(Cl. 27485), Koung to Kabayau, on rocks by path (Cl.
27690).
P. Grevilleana Wall.—*P. quadriaurita* var. *digitata* Bak.
1879: 40.—s.l. (Burbidge), Kiau to Lobang (Tp. 1605),
Lobang, on rocky slope in forest (H. 25556), Tenompok
(Cl. 28172).
P. longipinnula Wall.—*P. Toppingii* Copel. 1917: 47.—Kota
Belud to Kabayau (Tp. 1488).
The type specimen of Copeland's new species is identical
with a specimen from Pahang (Bentong, I. H. Burkill 16700,
Herb. Singapore), which I have compared with Wallich's
type at Kew.
P. Clemensiæ Copel. 1917: 47.—Lobang (Cl. 10348, H.
25722), Tenompok (Cl. 27909, 28095, 29311).—
Sumatra: G. Tandikat (Matthew 951).

Doubtfully different from *P. longipinnula*; the segments are closer and narrower.

P. flava Goldm. Hieron. Hedwigia 55: 337. 1914.—*P. quadriaurita* ex parte auctt., Copel. Keys 334; an Gepp p. 202 ?—Kamborangah, in valley forest, frequent near stream (H. 25521).

This agrees with the Philippine type in its stramineous rachises and light green leaf, differing somewhat in having fewer veins (10–13 pairs; in the type 20–22). Taking the species of this group in the same narrow sense as Hieronymus did, this form would be a new species.

P. baurita L.—Koung to Kiau (Tp. 1505), Kiau (H. 25595), Dallas (Cl. 27213, 27068). In open ground, especially on the edge of cultivation.

P. purpureorachis Copel. 1917: 48.—Lobang (Cl. 10350, Tp. 1790), Tenompok, occasional in forest (H. 25413, Cl. 28093), Dallas-Tenompok spur, in forest (Cl. 27730).

P. excelsa Gaud.—Kiau (Tp. 1538, 1568), below Dallas, on rocks by stream, in shade (H. 25275), Tenompok trail, on wet bank (Cl. 27118).

Copeland believed this to be an undescribed species, but I cannot find any essential difference between the specimens quoted and the Asiatic fern usually called *P. excelsa*.

P. decussata J. Sm.—s.l. (Low), Kiau to Lobong (Tp. 1613), Lobang, rocky place near stream (H. 25558).

P. longipes Don. var. **philippinensis** (Fée) C. Chr. ?—*P. philippinensis* Fée 10e Mém. 17, t. 33 f. 2; C. Chr. Index.—Near Menetendok, in forest near river (H. 25569), Dallas, east ravine (Cl. 27289).

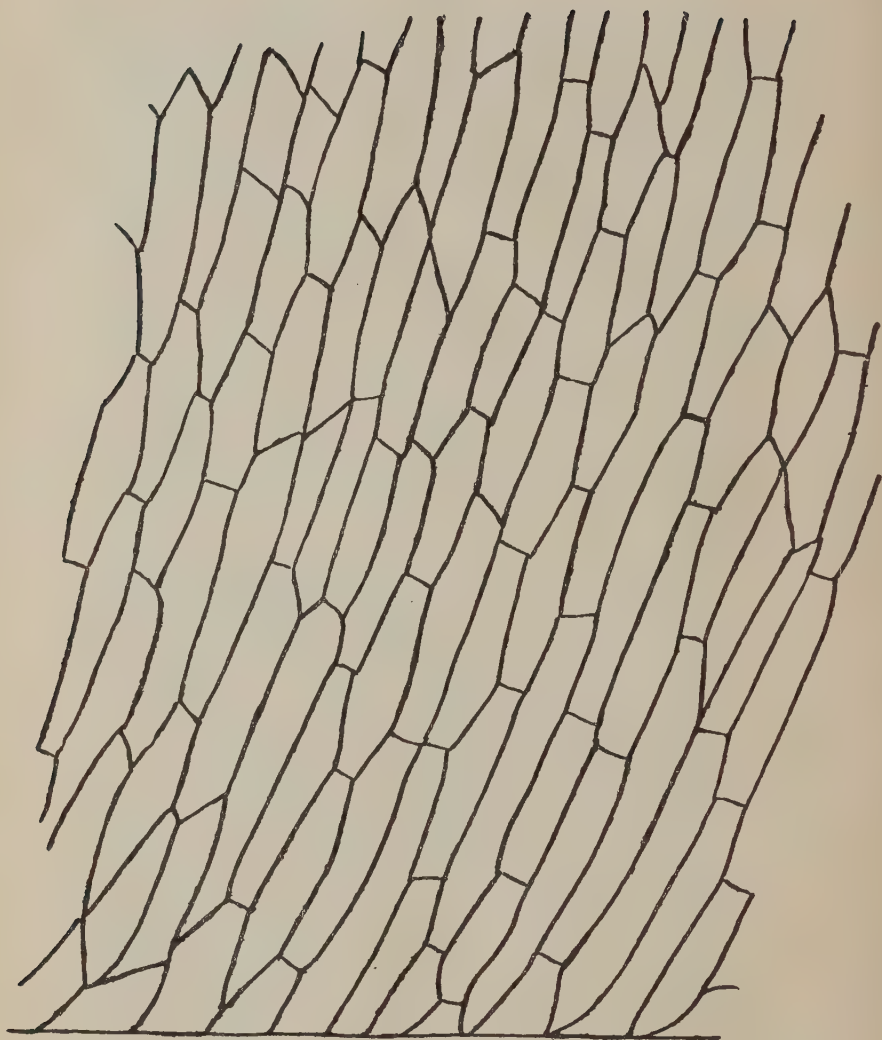
New to Borneo. Identical in almost all characters with the Himalayan type, but in Holtum's specimens (which are fully fertile) the basal pinnæ are bifurcate only, not fully pinnate, thus better agreeing with *P. quadriaurita* and its relatives, from which it is otherwise quite different. The pinnæ are short-stalked and long-caudate just as in Fée's species (Cuming no. 8), which I suppose to be very nearly the same. Clemens 27,289 has the basal pinnæ with two or three lateral branches on the lower side, the frond more broadly deltoid.

P. kinabaluensis C. Chr. n. sp.—*Eupteris* sect. *Tripartitae*, *P. longipedi* Don proxime affinis, differt: stipite rachibusque atropurpureis, segmentis integerrimis, apice rotundatis nec serratis, soris impressis, indusiis atrobrunneis.

KINABALU: Marei Parei ridge, in shady forest (H. 25614, type in Herb. C. Chr.), Tenompok (Cl. 29567), falls above Lumu, in gorge by spray of fall (Cl. 29973).

The characters given are quite sufficient to distinguish this pretty species from *P. longipes* and all others known to me. Other characters are as follows. Fertile fronds on longer stalks (60 cm.) than sterile. Basal branches 30–35 cm. long, with about 5–6 pairs of secondary pinnules and a terminal one, the central portion about 50 cm. long with 9 pairs of sessile pinnæ; pinnæ of the central portion 3 cm. wide, caudate-acuminate, incised into close, slightly oblique segments which are contiguous at their bases, quite entire, 4 mm. wide from the base to the bluntly rounded apex, firm-herbaceous, dark green; costæ deeply channeled above and bearing short spines at the bases of the segments. Veins very distinct, 7–8-jugate in a middle segment, distant, the upper nearly horizontal, all forked with spaced branches, the basal ones running out from the midrib of the segment and their lower branch often forked again near the edge. Sori about 1 cm. long, occupying the lower half or two thirds of both sides of the segments but not reaching the bottom of the sinus, impressed so that the upper side of the segment over them becomes vaulted; indusia entire and like the sporangia of a dark red-brown colour.

P. Holttumii C. Chr. n. sp.—*Litobrochia* rhizomate horizontaliter repente, 2 cm. crasso, lignoso, angulato, paleis perparvis, brunneis, exterioribus vix ultra 1 mm. longis, opacis, ovato-lanceolatis, interioribus multo minoribus, castaneis, lanceolatis vel subpiliformibus dense oblecto, radices tenues e lateribus emittente, a basi stipitis ramum brevem nascente. Stipite fere metrali, griseo-stramineo, ut toto folio glaberrimo sed parte inferiore (1 cm. crasso) squamulis parvulis adpressis mox abrasis vestito, aculeis conicis, rectis, 2 mm. longis vel multo minoribus muricatis. Lamina usque ad 2 m. longa, herbacea, pallide viridi, pinnata; rachi straminea, parte inferiore sparse muriculata. Pinnis multijugis, alternis, inferioribus 60 cm. vel ultra longis, 7 cm. latis, superioribus sensim minoribus, suprema 15 cm. longa, 2 cm. lata, cum terminale æquale subconfluente, infimis 10 cm. inter se remotis, omnibus sessilibus, lineari-lanceolatis, integerrimis, acuminatis, basi inæqualibus, antice rotundato-truncatis et interdum rachin tegentibus, postice breve rotundato-cuneatis et (superioribus solum) ad rachin adnatis; costis stramineis, superne sulcatis, subtus validis, prominentibus. Venis distinctis, more *Acrostichi aurei* dense reticulatis, areolas 8-10-seriatis, 4-6-gonales, elongatas, ca. 2–3 mm. longas 0.8–1 mm. latas formantibus, omnibus similibus, tenuissimis. Pinnis inferioribus



PTERIS HOLTUMII. Venation, $\times 3$.

sterilibus, medialibus et superioribus fertilibus, soris ex earum basi fere ad apicem continuis, maturis 2 mm. latis, indusiis scariosis, atrobrunneis, integris, angustis.

KINABALU: below Dallas, in wet ground by stream (H. 25363, type in Herb. C. Chr., Cl. 27229).

This splendid new species, which I dedicate to its collector, is the finest novelty discovered in recent years; it is of great interest, and should perhaps be the type of a new subgenus. Among the Malayan species it can only be compared with *P. Warburgii* Chr. (*P. finisterrae* Ros.) from Amboyna and New Guinea, but this has subdimorphous, deeply pinnatifid, not truly pinnate fronds, and the areoles are much larger. In size, division, and venation, our new species shows a remarkable resemblance to *Acrostichum aureum*, and this strongly supports the hypothesis that *Acrostichum* is derived from the *Pterideae*.

HISTIOPTERIS J. SMITH.

H. incisa (Thbg.) J. Sm.—s.l. (Haviland 1492), Pakka (H. 25519, Cl. 28972, 28018), Silau basin, rocks in river bed at 7,000 ft. (Cl. 29032).

H. stipulacea (Hook.) Copel. Phil. Journ. Sci. 3c: 347. 1909.—Tenompok, clearing by path (H. 25414, Cl. 28362).

var. *integrifolia* (Copel.) C. Chr. *H. integrifolia* Copel. l.c. 7C: 63. 1912.—Kiau (Cl. 10227), Gurulau Spur (Tp. 1623), Tenompok (Cl. 28268).

The type of this form looks distinct enough, but I have seen too many intermediates between it and *H. stipulacea* to regard it as a distinct species; moreover, I am by no means sure that both may be separated with certainty from *H. incisa*.

ELAPHOGLOSSUM SCHOTT.

E. Beccarianum (Baker) C. Chr.—Lumu Lumu to Kamborangah, on trees on the ridge (H. 25454, part).

In a former paper (Mitt. Inst. allg. Bot. Hamburg 7: 164), I made this a variety of the Peninsular *E. Norrisii* (Hook.) Bedd., and perhaps I was right. Both are very alike in most characters, *e. g.* the soft, light or reddish brown rhizome scales and the long-decurrent subsessile leaves, which however are oblanceolate and usually obtuse in *Beccariana*, lanceolate and acute in *Norrisii*.

E. callifolium (Bl.) Moore—Tenompok, on fallen tree (H. 25412, Cl. 29332, 28639).

This is the first certain collection of the species in Borneo, though a specimen from Dutch Borneo (Hans Winkler 960 a) may belong here.

E. decurrens (Desv.) Moore.—Tenompok to Lumu Lumu (H. 25427), Lumu Lumu to Kamborangah (H. 25454, part; 25717, 25718, Cl. 27060, 28019).—

SARAWAK: Mt. Matang (Ridley, Jan. 1915, Kew). New to Borneo.

Ridley's specimen and H. 25427 (a small one) from lower altitudes agree very well with Blume's plate 10, *i.e.* the fertile frond is much smaller than the sterile ones which are distinctly decurrent on the stipe, the rhizome scales are reddish brown, soft and sparsely fimbriate, the texture more or less coriaceous, the under side not glossy. Specimens from higher altitudes on Kinabalu look rather different, especially no. 25718. This is a large form: blade of the sterile frond up to 40 by 6 cm., oblanceolate, short-cuneate but hardly decurrent at the base, very thickly coriaceous, of a beautiful light leather-brown colour and glossy beneath when dried, the costa flat beneath, 5 mm. broad below, the veins quite hidden, the stipe 8–12 cm. long. Fertile blade on a longer stipe, elliptical, 20 by 5 cm., abruptly rounded at the base. The smaller specimens, nos. 25454 and 25717, belong to the same form but their decurrent fronds are so near the type that I dare not now segregate this Kinabalu form as a species: it can perhaps be made a variety, *var. crassum*.

I may add here that *E. Cumingii* (Fée) Moore, united by most authors with *E. decurrens*, is to me a distinct species, marked by the leaves being densely fringed with rufous scales; no trace of such marginal scales are to be found in *E. decurrens*. A close relative of this is *E. permutatum* v. A. v. R. Bull. Jard. bot. Buitenz. II ser. XVI: 13. 1914 (Sumatra: G. Sago, Matthew 696), which differs in its elliptical, acuminate and hardly decurrent sterile leaves of rather thin texture, and in its very long-stalked fertile leaves, the lamina of which is 7 cm. long by 1.5 cm. wide only, and not decurrent. Intermediate between *E. permutatum* and *E. decurrens* is a specimen from G. Tahan, Pahang (H. 20750), the sterile fronds of which are typical *decurrens* but the fertile ones are like *permutatum*.

E. angulatum (Bl.) Moore—*E. laurifolium* auctt. Copel. Keys 411.—Pakka, on trees near stream (Cl. 10719, H. 25508, Cl. 28020).

Differs from the former species by the wide-creeping rhizome, which is clothed with broad ovate, reddish brown scales; similar scales are scattered along the stipes and costa beneath. The leaves are uniform, the stipes up to 10 cm., articulated to dark-coloured pseudopodia 1 cm. long, the lamina to 15 by 2.5 cm., narrow-elliptical, equally short-attenuate to both ends, the cartilaginous margin broad and

wavy, texture coriaceous, the under side bearing scattered minute scales. I am sure that my determination is right; the specimens agree excellently with Blume's plate 6 and also with Fée's figure (Acrost., pl. 7), but this Malayan form is scarcely identical with the genuine *Acrostichum laurifolium* Thouars from Tristan d'Acuna. *E. laurifolium* Christ and v. A. v. R. is, at least partly, *Acrostichum commutatum* Mett. (*A. conforme* Bl. pl. 5) a very similar plant with a shorter rhizome and not unlike typical *E. conforme*; but I am by no means sure that the two "species" illustrated by Blume are really different.

E. petiolatum (Sw.) Urban, sens. lat., var.—Tenompok, on large tree (H. 25357), falls above Lumu (Cl. 29709), Silau basin (Cl. 29064).—
SARAWAK: Mt. Murud (Mjöberg).

I have little doubt that the Asiatic forms usually referred to *E. petiolatum* are specifically different from the American and African ones, and moreover that they belong to more than one species, but I am not able at present to unravel these intricate forms. The Bornean specimens under examination differ from most others in the character of the scales on the lower surface of the sterile fronds. These scales are more numerous, peltate and nearly circular, with short cilia (in most other forms of the species the scales are fewer and stellate, with a very small disc and long arms). The upper surface is naked beyond the costa, but in the fertile frond densely matted with rufous fimbriate small scales. The stipe of the sterile frond is 13–15 cm. long, the lamina lanceolate or linear-oblong, 25–30 by 3–3.5 cm. The stipe of the fertile frond is 20 cm. long, the lamina linear, 20–30 by 1–1.2 cm. The rhizome is creeping, the scales narrow, linear-lanceolate, castaneous, the stipes about 1 cm. apart.

SCLEROGLOSSUM v. A. v. R.

In my monograph of this genus (Dansk Bot. Arkiv 6 no. 3: 25. 1929) I tried to distinguish a small number of closely related species, which I fear cannot all be maintained as good ones.

S. debile (Kuhn) v. A. v. R., C. Chr. l.c. 26, pl. 2.—Marei Parei ridge, on mossy tree trunk (H. 25613).

A doubtful form with very narrow leaves (under 1.5 mm. wide) and interrupted, slightly immersed sori; in size and habit like a small *Monogramma*.

S. pusillum (Bl.) v. A. v. R., C. Chr. l.c. 27, pl. 2.—Pakka to Lobang (Cl. 10722), Marei Parei ridge (H. 25179), Lumu Lumu to Kamborangah (H. 25464), Lumu to Pakka (Cl. 28982, 29104).

var. **angustissimum** (Copel.) C. Chr. l.c. 28, pl. 2. *S. angustissimum* Copel. 1917: 65.—Marei Parei ridge (Cl. 11048), Kamborangah (Cl., s.n.).

S. minus (Fée) C. Chr. l.c. 29, pl. 2.—Kamborangah (H. 25542).

New to Borneo. A form with thick narrow rush-like leaves; it differs from the former species by the marginal sori-grooves. Perhaps it is not really different from the following species.

S. sulcatum (Kuhn) v. A. v. R., C. Chr. l.c. 28, pl. 2.—Pakka (Haviland 1481, Cl. 10722, H. 25736), above Pakka, on rocks (Cl. 27998).

OREOGRAMMITIS COPELAND 1917: 64.

O. Clemensiæ Copel. l.c., C. Chr. Dansk. Bot. Arkiv 6 no. 3: 30, pl. 3.—Low's Peak (Cl. 10618 p.p.), under an overhanging rock at 13,000 ft. (H. 25484).

Certainly a distinct species, but the validity of the genus is very problematical.

POLYPODIUM LINN.

The genus is here taken in the wide sense of the Index, though it is, in my opinion, a tribe, not a genus. The problem of splitting it up into well defined and natural genera is, however, beset with many difficulties which have still to be overcome. In his paper on the Oriental Genera of Polypodiaceæ (1929), Copeland proposes to restore a number of old genera, but I am not quite satisfied with his treatment.

Series I. Species with all veins free

GRAMMITIS (Swartz).

P. kinabaluense Copel. 1917: 60.—Pakka to Low's Peak (Cl. 10649, 10618 part), Pakka, in rock crevices and on a tree (H. 25483, 25745, 25873, Cl. 27990, 27783).

A small, glabrous species with densely tufted, subcoriaceous, oblanceolate or spatulate leaves and somewhat impressed sori. The best character, overlooked by Copeland, is found in the sporangia, which when young are furnished with 2-5 red-brown setæ, which entirely cover the young sori; these setæ soon fall and are sometimes lacking in old sori. By this character the species differs from *P. universe* Baker, which is smaller, with the naked sporangia mixed with long hairs.

P. malaicum v. A. v. R. Handb. Mal. Ferns 577. 1909.—*P. sessilifolium* Hook. Spec. Fil. 4: 168 pl. 268A. 1863 (not. Liebm. 1849).—Kamborangah to Pakka (H. 25479, 25744), Menerintog (Cl. s.n.).

I have little doubt that this determination is right, though the young sporangia are setose with the setæ clustered at the apex, which character has never been mentioned for the species; the setæ however fall early and are not to be found on mature sporangia. Specimens from Luzon (Copeland: Pterid. Philip. exsic. 141, *P. sessilifolium*) agree well with Hooker's figure, but have setose sporangia like the Kinabalu fern. The species, which is also known from the Peninsula, is closely related to *P. kinabaluense*, differing in its thinner, nearly herbaceous texture and larger size; the largest leaves are 12 cm. long by 4–5 mm. wide (those of *P. kinabaluense* are 4–5 cm. long, most being much smaller). The leaf margins are more or less repand-sinuate, and most of the veins are forked. The species has often (as in my Index) been united with *P. subevenosum* Bak., but this has apparently naked sporangia and most veins simple. *P. Maxwellii* Bak. from Sarawak seems to be quite identical with *P. subevenosum*; the name *P. Maxwellii* cannot therefore be substituted for the invalid *P. sessilifolium* Hk. as suggested by Copeland (Keys 393).

P. caespitosum (Bl.) Mett.—In rock crevices at 12,000 ft. (H. 25496).

New to Borneo. Apparently a rare species, known from Java and Luzon. The few leaves seen are not quite typical, the long thread-like stipe being very sparsely hairy with short hairs, not densely short-hairy as in the Javanese type; in this respect they agree better with a specimen from Luzon (Mt. Pulog; Copel., Pterid. Philip. exsic. 135). A single detached leaf from Kinabalu (H., s.n.), probably belonging to the same form, is exceedingly like the Papuan *P. locellatum* Baker, which differs from *P. caespitosum* by its nearly glabrous stipe and linear, not lanceolate, blade; very likely *P. locellatum* is a form of *P. caespitosum*. These small ferns are easily recognised by their coriaceous, glabrous, lamina, long slender stipe, and deeply immersed oblique and oblong sori.

P. fasciatum (Bl.) Presl; Gepp 203, part.—Below Pakka, erect on mossy rocks in low forest (Gibbs 4265 bis, Cl. 10717, H. 25477, 25870, Cl. 27050, 27059, 28987B, 30462, 27999), Pakka (Tp. 1663, 1718), Silau basin (Cl. 29061).

This is one of the few upright-growing species of *Grammitis*.

P. padangense Baker—*P. durum* Copel. in Elmer's Leaflets 3: 837. 1910.—*P. ciliiferum* v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XVI: 32. 1914.—*P. fasciatum*, part, Gepp 203.—Below Pakka (Gibbs 4272, Cl. 27997, 28987A).

New to Borneo; known previously from Sumatra and Mindanao. I see in my notes that Gibbs 4272 (Brit. Mus.) is exactly identical with Elmer 11689 from Mt. Apo (Herb. Copeland), the type of *P. durum*, which is quite the same as the type of *P. padangense* from Mt. Singgalang, Sumatra, coll. Beccari (Herb. Inst. Bot. Firenze); and Matthew 708 from Mt. Sago, Sumatra, the type of *P. ciliiferum*, is also the same. *P. padangense* somewhat resembles *P. fasciatum* in size and shape of the leaves, but it is more coriaceous, the leaves subsessile and furnished with scattered, soon abraded, blackish bristles along the margins, and the *sporangia* are *setose*. The short-creeping rhizome is covered with ovate, pale brown, rather large scales.

P. obscurum (Bl.) Mett., v.A.v.R. Handb. 586.—*P. Reinwardtii* var. C. Chr. Index.—*P. ludens* Baker Ann. Bot. 8: 129. 1894.—Pakka (H. 25871).

Also new to Borneo; previously known from Java, and perhaps Papua. This species is very near *P. padangense*, and hardly different as to scales, size, texture, sparsely ciliated margins and setose sporangia, but the lanceolate (not linear) leaves are stalked with a rather densely pilose stipe 2–4 cm. long. The oblique sori are more deeply impressed and borne on nearly linear receptacles, oblong when mature (round in *P. padangense*). The specimen quoted matches the figure of *Grammitis obscura* Blume, Flora Javæ pl. 50, and I am fairly sure that Blume's plant is the same, and that it is not a variety of *P. Reinwardtii* as Mettenius believed. *P. ludens*, from Java (Hancock 53a), differs very slightly, having somewhat longer stipes and more acuminate leaves, some of which are irregularly lobed; it can scarcely be considered a variety.

P. dolichosorum Copel. Phil. Journ. Sci. 1 Suppl. II: 159, pl. 16. 1906.—Erect, on mossy rocks by river below Kamborngah (H. 25533).

This species, allied to *P. padangense* and agreeing in hairiness of stipe and frond, oblique sori and setose sporangia, differs markedly in its very long slender creeping rhizome, with rather distant fronds which grow stiffly erect; the dried fronds are also brown and not nearly so dark as those of *P. padangense*. The acroscopic vein which bears the sorus sometimes joins with the vein next above.

P. lasiosorum (Bl.) Hook. ?—Kamborngah to Pakka (H. 26872).

A very doubtful, small form of the group of *P. hirtellum*. It differs from *P. bongoense* and agrees with the Javanese *P. lasiosorum* in its subcoriaceous texture with indistinct veins, and in the setose sporangia. It is almost impossible

to name with certainty the many Malayan species of this group without direct comparison with type-specimens, most of them being imperfectly described.

P. bongoense Copel. Phil. Journ. Sci. 38: 153. 1929 (nom. nov.).—*P. Brooksii* Copel. l.c. 12c: 60. 1917 (not C. Chr. 1913).—*P. lasiosorum* Gepp 203 ?—*P. hirtellum* part Copel. Keys 393 ?—Above Lumu Lumu (H. 25737, Cl. 27996, 28968A), Marei Parei spur (Gibbs 4062?, Tp. 1880?), Tenompok (Cl. 27792).

A. critical species, closely resembling *P. hirtellum* Bl. but the hairs longer and the fertile veinlet very short as in *P. Reinwardtii*. Some of the numerous specimens are however short-hairy like typical *P. hirtellum*. No. 25737 agrees tolerably well with the type from Sarawak; the sporangia are naked as in *P. hirtellum* and the veins somewhat raised beneath. I have noted that Gibbs 4062 (Brit. Mus.) shows the same characters and belongs presumably to this species.

P. Reinwardtii (Bl.) Presl.—Marei Parei ridge (Cl. 11047), Tenompok, pendulous on mossy trees trunks (H. 25399), Kamborangah (H. 25738).

Veins very distinct, subhorizontal, the fertile branch very short, sporangia naked.

P. Reinwardtii var. an sp. nov. ?—Tenompok to Lumu Lumu (H. 25743).

Like the type in size, pubescence and venation, but the sporangia bear a single lateral bristle just as in the Philippine *P. Jagorianum* Mett. (Berlin !); the marginal hairs of that species are however fascicled in groups of 3 to 5, and it is a much smaller species of subcoriaceous texture. *P. Koordersii* Christ from Celebes is, I think, the same. *P. Jagorianum* was evidently misunderstood by Copeland, who distributed under that name a quite different species (Pterid. Phil. exsic. 70), related to *P. hirtellum* but larger and with setose sporangia.

P. Warburgii Christ—*P. pubinerve* Christ, Ann. Jard. bot. Buitenz. 15: 146. Gepp 203. Copel. Keys 394.—Below Pakka (Gibbs 4255), Kamborangah (H. 25741), Marei Parei spur (Cl. 11064), above Lumu (Cl. 27991), Silau Basin (Cl. 29035).

Somewhat resembling *P. Reinwardtii*, but much more robust. Leaves up to 25 cm. long by 1 to 1.5 cm. wide, with red hairs on the midrib and margins only; firm in texture, with the veins raised beneath; all veins very regularly forked at the middle and bearing in addition an acroscopic basal branch which, when fertile (in the upper half of the lamina), is short as in *P. Reinwardtii*. The sporangia are naked, but mixed with a few long hairs.

I cannot say definitely that *P. Warburgii* is the oldest name for this species, but I have little doubt of the identity of the Kinabalu plants with Christ's type from Batjan (Berlin!), and with the Celebes plant called *P. pubinerve* by Christ and later authors. It is, however, certainly not *Grammitis pubinervia* Bl., Fl. Jav. 117, pl. 48, for Blume says expressly that the lateral veins are conspicuous, *but only when the leaf is seen against the light*, and the very distinct raised veins are the predominant character of our present species.

P. congenerum (Bl.) Presl.—Marei Parei spur (Cl. 10920 part), Pakka to Lobang (Tp. 1735), Tenompok (H. 25742 ?, a scanty and hardly determinable specimen).

P. setigerum Bl.—Kamborangah (H. 25739).

The specimen agrees exactly with this species as figured by Hooker (Ic. Plant. 941) and as represented by several specimens from G. Gedeh in Java. The rhizome, described by Blume and v.A.v.R. as densely scaly, is so only at the apex, which is covered with small scales; the scales on the older parts of the rhizome, if present, are obscured by the thick mat of long hairs on the closely tufted stipes. The thin leaves, with the branched veins visible only against the light, often have white dots covering the hydathodes on the upper surface. The species is new to Borneo.

P. Havilandii Baker 1894: 253.—*P. multisorum* Copel. 1917: 61.—s.l. (Haviland 1488), Pakka, on mossy tree trunks (Tp. 1665!, 1668, 1682, 1711, H. 25478), Kamborangah (Cl. 27995).

Copeland failed to identify Topping's collection with Baker's species because Baker described the sori as uniseriate, though in the type-specimen at Kew they are distinctly 2-3-seriate; Topping's specimens are exactly identical. The species, known only from Kinabalu, is a most distinct one, especially on account of its peculiar pubescence. The small, short rhizome is apparently scaleless, with numerous fascicled leaves. Stipes 3-4 cm., densely pilose with pale brown, patent, very slender hairs 1-2 mm. long. Lamina (of H. 25478) up to 20-25 cm. long by 1 cm. wide, linear in outline, the edges of the larger fronds rather deeply sinuate-crenate, firmly herbaceous. Upper side, margins, midrib and veins beneath, and receptacles, softly pubescent or subvillous with long pale simple hairs, the leaf-tissue of the under side covered with very short clustered or stellate hairs. Veins indistinct, forked at the apex, bearing one or two pairs of lateral branches which are all fertile; sori in two or three rows but rather irregularly scattered, superficial, completely covered with long hairs; sporangia small, naked. The leaf is often fertile almost to the base.

P. sumatranum Baker.—*P. subpleiosorum* Racib., C. Chr. Index.—Marei Parei spur (Cl. 10920 part), near Pakka, on tree trunks near river (H. 25503), above Pakka, on rocks (Cl. 27065), Silau basin at 7,000 ft. (Cl. 28240).

Rhizome scales light brown, entire; stipes with many short hairs; lamina often deeply lobed, with a few bristles, soon quite glabrous; young sori linear, round when old. The description given by v.A.v.R., Handbook p. 587, is good.

P. calcipunctatum Copel. 1917: 61.—*P. pleiosoroides* Gepp 203.—Kamborangah, abundant on trees near river, pendulous (Gibbs 4141, Cl. 10530, H. 25480, 25532).

A very distinct species which grows much larger than described by Copeland. The smaller forms resemble *P. setigerum* in pubescence and venation, but the sori are different from most species of this group; they are dark brown and densely ciliate. The upper side bears numerous calcareous dots secreted from the hydathodes. H. 25532 is a much larger plant with the same scales, pubescence of long hairs and white dots above. The largest leaf is 40 cm. long by 3 cm. wide and irregularly sinuate-crenate or rather deeply lobed with unequal lobes; it resembles *P. sumatranum* so much that the two might be confused, especially as the older leaves are subcoriaceous and lose their hairs. The different scales and long hairy stipes mark *P. calcipunctatum* clearly when seen in the herbarium; in the field its pendulous habit at once distinguishes it from *P. sumatranum*. The sporangia are setose. The species is known from Kinabalu only.

CALYMMODON (Presl).

Copeland has recently restored to generic rank this group of small pinnatifid or subpinnate species (Phil. Journ. Sci. 34: 259-269. 1927). I should not hesitate to adopt this genus if I could see clearly how it may be limited so as to separate it from other small free-veined Polypodia. I prefer for the present to retain the species in *Polypodium*.

P. cucullatum Nees and Bl. *Calymmodon cucullatum* Pr., Copel. l.c. 261.—s.l. (Low), Gurulau spur (Gibbs 4018 bis, a scrap; Tp. 1816, a small form, called by Copeland *P. muscoides*), Kamborangah to Pakka (Tp. 1659, part), Marei Parei spur (Cl. 11044 part), Lumu Lumu to Kamborangah (H. 25732).

var. **subgracillimum** (v.A.v.R.) C. Chr. comb. nov. *P. subgracillimum* v.A.v.R. Bull. Jard. bot. Buitenz. II ser. VII: 40, pl. 3 f. 2. 1912.—s.l., 10500 ft. alt. (Haviland 1482), Gurulau spur (Gibbs 4017), Marei

Parei spur (Cl. 11044 part), Pakka, in mossy forest near stream (Tp. 1713, H. 25500), Dachang (Cl. 29058), Kamborangah (Cl. 28085).

Copeland quoted *P. subgracillimum* as a synonym of *C. cucullatus*; he may be right in regarding the former as not specifically distinct, but it seems to me so different from the form here taken as typical *cucullatum* that I make it a variety. It differs by its much longer and much narrower leaves (up to 20 cm. long by 4–5 mm. wide), with the lower sterile segments tooth-like, and the scales usually less evident. It is glabrous.

P. consociatum v.A.v.R. Bull. Jard. bot. Buitenz. II ser. VII: 41, pl. 4. 1912. Handb. Suppl. 352 (excl. syn.), C. Chr. Gard. Bull. S. S. 4: 403.—*Calymmodon gracilis* (Fée) Copel. l.c. 266.—*Pol. muscoides* Copel. Keys 395, part.—Marei Parei ridge (Tp. 1846), Tenompok to Lumu Lumu abundant on mossy tree trunks (H. 25428), s.l. (Cl. 30461).

This appears to be a common fern in the mossy forests of Borneo and the Philippines, but it is less common in the Malay Peninsula. It is a small species (leaves usually 4–5 cm. long, 5–6 mm. wide), with subequal sterile and fertile segments, pubescent with scattered long pale hairs. The fertile segments of most specimens are not folded, but quite plane with a central sorus. Copeland named Topping 1846 *P. muscoides* Copel., but it fits his own description badly and agrees much better with the present species, though differing in its obscurely sinuate-crenate fertile segments. A new species?

P. clavifer Hook.—s.l. (Low, Burbidge), Marei Parei ridge (Cl. 11043), Kamborangah (Gibbs 4140, H. 25465, Cl. 27065A, 28315, 28000, 28979), Kamborangah to Pakka (Cl. 29104A).

ACROSORUS (Copeland) : *Davallia* sp., C. Chr. Index.

A small group of true polypodioid ferns, quite unrelated to the davallioid genera but near *Calymmodon* and approaching *Prosaptia*; if we retain these two groups in *Polypodium*, we must also make *Acrosorus* a section of that genus.

P. streptophyllum Baker 1879: 42.—*P. triangulare* Scort., *Acrosorus triangularis* Copel. Phil. Journ. Sci. 3C: 347. 1909.—*A. exaltatus* Copel. l.c. 1 Suppl. 159, pl. 15. 1906, *Davallia* Copel. 1905, C. Chr. Index 663, *Polypodium* Copel. v.A.v.R. Handb. 614.—*Davallia Frederici et Pauli* Christ 1895, *Acrosorus* Copel. l.c. 1 Suppl. 159, *Polypodium Sarasinorum* v.A.v.R. l.c. 615.—Lumu Lumu to Kamborangah (Enriquez 18163, H. 25473), Kamborangah (Cl. 27992), Tenompok (Cl. 29506).

After comparison of the four "species" here united, I am convinced that this treatment is correct. Small differences may be pointed out, but these are only such as may be expected within a species of wide distribution. I regard the forms as geographical races. Baker's type from North Borneo (Burbidge, Kew) is apparently identical with *P. triangulare* from the Peninsula, and the Philippine *A. exaltatus* and *P. Sarasinorum* from Celebes are hardly so different that they may be segregated as varieties.

GROUP OF *P. DENTICULATUM*.

Small pinnatifid or subpinnate species some of which resemble the smaller species of *Calymmodon*, from which they may usually be distinguished by their segments being emarginate or toothed with 1-3 teeth and often bearing 2-4 sori. If a single sorus and a single tooth only are present, they are placed near the base of the segment, which is never folded. The species fall into two (or more?) smaller groups: (1) herbaceous and often glandular-pubescent, (2) rigidly coriaceous and nearly or quite glabrous species. Intermediate species occur, e.g. *P. Matthewianum* v.A.v.R. *P. subpinnatifidum* Bl.—Marei Parei spur (Cl. 11072), Kamborangah (H. 25740).

A species of uncertain systematic position; it shows affinities to *Grammitis*.

P. alternidens Cesati—s.l. (Burbidge), Kamborangah (Gibbs 4229), Pakka to Lobang (Cl. 10721).

I suspect that some or all of the above specimens belong to *P. Hieronymusii*, a species unknown to me when I examined them. The genuine *P. alternidens* from Sarawak is a small species of thinner texture, the leaves 3-4 cm. long by 1 to 1.5 mm. wide, the minute, entire, tooth-like lobes very ascending.

P. bryophyllum v.A.v.R. Bull. Jard. bot. Buitenz. II. ser. XVI: 35. 1914 Handb. Suppl. 366.—Lumu Lumu to Kamborangah, on mossy tree trunks (H. 25467).

New to Borneo; known previously only from Penang (Matthew 499, 924). This species is very like *P. alternidens*, but a little larger, and densely glandular-pubescent with short glistening articulated hairs.

P. papillatum v.A.v.R. l.c. pl. 7, Handb. Suppl. 367.—Marei Parei ridge, on mossy trees (H. 25604, *forma minor*).

New to Borneo. A much smaller form than the type from G. Sago, Sumatra (Matthew 693), the leaves 7-8 cm. long by 5-7 mm. wide only, but I cannot find any other essential difference. It agrees with *P. bryophyllum* in pubescence, but it is nearly fully pinnate, the pinnæ with 1 or 2 small lobes above in addition to one lobe below.

P. minutum Bl., C. Chr. Gard. Bull. S.S. 4: 402.—*P. cucullatum* part, Gepp 203.—Gurulau spur (Gibbs 4018). Also on Mt. Tibang (Mjöberg).

This differs from the two preceding species in the midrib, margins and sori being clothed with long very thin hairs; the segments each bear a basal sorus, and often also one near the tip.

P. Hieronymusii C. Chr. Index.—Kamborangah to Pakka, on bases of tree trunks and on rocks (Tp. 1659 part, H. 25476, Cl. 27989), Tenompok (Cl., s.n.).

New to Borneo, but probably confounded with *P. alternidens*, q.v. *P. Hieronymusii* differs from *P. alternidens* by its rigidly coriaceous texture, much longer (up to 10 cm.) leaves with patent or somewhat oblique segments which are often furnished with an upper basal tooth.

P. cornigerum and *P. alternidens* Ridley, Journ. Mal. Br. R. Asiatic Soc. 4; 82–83, belong here, at least specimens from Pahang (nos. 20734, 23307) and Johore (10680) received from Holtum under these names. The type came from Malacca (Cuming 380 ! at Berlin).

P. denticulatum (Bl.) Presl.—Gurulau spur (Cl. 10855), near Tenompok, on mossy tree trunk, rare (H. 25731), Dallas-Tenompok ridge (Cl. 28157).

CTENOPTERIS (Blume, Kunze, Bot. Zeit. 1846: 425).

Under this name I unite a considerable number of Malayan-Polynesian (and other tropical) species which are of medium size, pinnatifid or subpinnate with free veins, of firm to coriaceous texture, the leaves tufted on a short rhizome, the scales of which are entire, rarely ciliate, the sori superficial or slightly impressed, rarely deeply immersed, the sporangia naked. The group is certainly a natural one, but it should perhaps be widened to include *Cryptosorus*, as it must be admitted that no clear boundary exists between the two groups.

P. Moultoni Copel. Phil. Journ. Sci. 10C: 149. 1915.—*P. blechnoides* Baker 1894: 253, Copel. Keys 197.—*P. revolvens* v.A.v.R. Bull. Jard. bot. Buit. III ser. 2: 170, 1920.—*P. pseudorevolvens* v.A.v.R. l.c. 5: 219. 1922.—s.l. (Haviland 1487), above Kamborangah (Cl., s.n.).

To this species I refer all specimens from the Malayan region and Ceylon which have been named either *P. decorum* Brack. or *P. blechnoides* (Grev.) Hk. They resemble closely the former, the type of which came from Tahiti, in size and general habit, but differ in some minute characters; the sori are slightly impressed, not deeply immersed, and the peculiar hairs are different. The hairs are confined to the under side of the black midrib and the margins of young leaves, and are short and soft, light brown and variously branched, the basal portion and branches of

the same structure. The hairs of the genuine *P. decorum* consist of an appressed basal, whitish, opaque, membranous portion which bears on the upper side 1-4 erect, subulate, rigid, castaneous and glossy setæ. The original *P. blechnoides* from Tonga is, I believe, the same as *P. decorum* and not identical with *P. contiguum* and *Cryptosorus Seemannii* J. Sm. as stated by Hooker. *P. Moultoni* is apparently a common fern in Borneo, the Malay Peninsula, and the adjacent islands; it is the only common small *Polypodium* in the lowland forest, occurring frequently in old mangrove as well as inland forest and also on the mountains. It is not common on Kinabalu, and probably occurs on the lower slopes. (C. Chr.).

I have seen the types of both *P. revolvens* and *P. pseudorevolvens*. The differences between them are in my opinion not significant, and fall well within the range of variation of this common species. (R.E.H.).

P. mollicomum Nees & Bl.—*P. minutum* Baker 1879: 42.—*P. malaccanum* Baker? Gepp 203, Copel. Keys 396.—s.l. (Burbidge), Pakka (Gibbs 4251, Tp. 1714), Marei Parei spur (Cl. 11049), Lumu Lumu to Kamborangah (H. 25461, Cl. 27994, 28969, 28967), above Pakka? (Cl. 27756).

Basal scales castaneous, narrowly linear-lanceolate, furnished with a few long and very thin deciduous hairs and with a tuft of 3-5 similar hairs at the apex, the frond more or less densely pubescent with rufous hairs, the pinnules linear-oblong, not much widened at the base. The specimens referred here look rather different, and belong perhaps to two species; they vary especially in the density of the pubescence and in the size and shape of the pinnæ. Those with broader pinnæ and longer fewer hairs are like *P. brevivenosum* v.A.v.R., but are much bigger than the type of that species; it is very probable that the type in question is a young plant, immature as to size but already fertile.

P. subminutum v. A. v. R. Handbook 598.—*P. minutum* Syn. Fil. 328 p.p.—*P. repandulum* forma *pilosa* v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XVI: 36. 1914.—Lobang (Tp. 1768, H. 25550), Tenompok to Lumu Lumu, on mossy tree trunks (H. 25431).

This species was described from two very small plants collected in Java by Forbes. Subsequently the author considered it to be only a form of *P. repandulum*, and as such referred to it a number of specimens, chiefly from Sumatra, most of which I have been able to examine. *P. repandulum* however is so distinct in having rather sparse branched hairs, and also in its more distant, more oblique and more coriaceous pinnæ, that in my opinion the

"forma pilosa" should be regarded as a separate species. Amended diagnosis is as follows:

P. subfalcato Bl. affinis, differt: pinnis repandis vel crenatis, non dentatis, subtus sat dense breve pilosis.

A typical collection is: Sumatra, G. Kœrintji, Bûn-nemeijer 9311; duplicates of this have been distributed to a number of herbaria.

The fronds are tufted, usually about 15–20 cm. long by 2.5 cm. wide, the pinnæ separated by about twice their own width, 1.5 to 2.5 mm. wide, almost at right angles to the rachis or somewhat oblique, tapered to a narrow rounded apex, dilated towards the base and broadly adnate to the rachis and decurrent below, their edges more or less repand or crenate, texture thin and somewhat translucent; the lower pinnæ gradually reduced and extending to the base of the stipe; the stipe and rachis above and beneath copiously rather shortly hairy, the hairs very slender, pale brown, simple, not branched at the base, similar shorter hairs more or less densely distributed over the lower surface of the pinnæ; sori terminal on veins, which reach $\frac{2}{3}$ distance towards the margin and terminate in hydathodes on the upper surface. There is some variation in the denseness of the pubescence of the pinnæ. (R.E.H.).

I have seen specimens from Ceylon, Sumatra, Java, the Malay Peninsula and Borneo. In Sumatra the species is very common on mossy trees in mountain forests at about 6000–8000 feet altitude, and sometimes has fronds as much as 32 cm. long. *P. subfalcatum* Bl. is rather similar, but quite distinct in its more sparse but longer hairs and distinctly dentate pinnæ. Of the Kinabalu plants Copeland referred Topping 1768 to *P. subfalcatum*. H. 25550 has on some plants unusually broad fronds, up to 3.5 cm. in width.

***P. nutans* Bl.**—Pakka to Lobang (Tp. 1732, det. Copeland), Pakka (Cl. 28978).

This species approaches the following group by its short creeping rhizome which is covered with dark brown ciliate scales, but the hairs on the scales are softer and the sori are not immersed. The frond is hairy on the rather long stipe and the midrib beneath only, the hairs blackish-brown, very short and usually clustered 2–5 together.

CRYPTOSORUS (Fée).

Pectinately divided species with short creeping rhizome which is clothed with subclathrate, black-brown and spinescent-ciliate scales, the sori remote from the margin and sunk in deep cavities which are usually fringed with hairs. A fairly natural group, but not very sharply distinct

from *Ctenopteris* on the one hand and *Prosaptia* on the other.

P. venulosum Bl.—On the ridge above Kamborangah (H. 25524 bis), Dachang (Cl. 28441). New to Borneo.

P. obliquatum Bl.—Copel. Keys 396.—Recorded by Copeland; no specimen seen.

P. celebicum Bl.—Marei Parei spur (Cl. 11050), Kamborangah, pendulous from trees near river (H. 25524), falls above Lumu (Cl. 29912), Silau basin, on rocks by stream (Cl. 29044).

Very near *P. obliquatum*, differing chiefly by the less oblique sori and by the edges of the cavity not being raised but densely fringed.

P. khasyanum Hook.—Silau basin at 7000 ft. (Cl. 29029).

Differs from *P. Burbridgei* in the rachis being hardly winged, and the sori only on the distal parts of the lobes.

PROSAPTIA (Presl).

This group has recently been restored to generic rank by Copeland and others; to this I should agree if I could see how *Prosaptia* may be distinguished from *Cryptosorus*, and retaining the latter in *Polypodium* involves the retention also of *Prosaptia*. The species of both groups are quite similar in habit, texture, pubescence and in the structure of the scales, but in *Prosaptia* the deeply immersed sori are marginal and often protruding beyond the margin, which is the only reliable difference between the two groups.

P. Emersoni (Hook. & Grev.) C. Chr. comb. nov.—*Davallia Emersoni* Hook. & Grev. Ic. Fil. pl. 105.—*D. alata* Bl., C. Chr. Index (not *Polypodium alatum* L.), *Prosaptia alata* Christ, Copel. Keys 407.—*Polypodium serraeforme* (Wall.) J. Sm. 1841 (nom. nud.) v.A.v.R. Handb. 615.—Below Dallas, on tree by stream (H. 25366).

P. contiguum (Forst.) J. Sm.—*Davallia contigua* Spr., C. Chr. Index, Baker 1879: 39, 1894: 251, Gepp. 199.—*Prosaptia contigua* Pr., Copel. Keys 407.—s.l. (Burbridge, Haviland 1484), below Kamborangah (Gibbs 4138, Tp. 1640), Lumu Lumu (H., s.n.), Tenompok (Cl. 28681, 26981), Dachang (Cl. 28317).

P. davalliaceum Baker. *Prosaptia* Copel. Univ. Cal. Publ. Bot. 12: 404. 1931.—*Polypodium monocarpum* Rosenst. Fedde Repert. 12: 178. 1913.—*Prosaptia linearis* Copel. Phil. Journ. Sci. 4C: 115. 1909 (not *Polypodium lineare* Thb.); Keys 407.—*Polypodium acrosoroides* v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XI: 21. 1913; Handb. Suppl. 371.—*Davallia contigua* var. *monosora* Gepp 199?—Below Pakka (Gibbs 4275?, Tp. 1715, H. 25506), above Kamborangah, on rocks and trees (Cl. 27993).

Copeland was quite right in identifying Rosenstock's species with Baker's; I have co-types of both, from New Guinea. The Kinabalu form matches exactly the type from New Guinea, and is somewhat larger than *Prosaptia linearis* Copel. from Luzon, which is otherwise quite the same.

GROUP OF *P. GRAMMITIDIS*.

An isolated group of few known species which in cutting and size resemble some species of *Cryptosorus* and *Prosaptia* but in all important characters are quite different. The short creeping rhizome is covered with brown, entire and rather soft scales, the leaves grass or light green, papyraceous to subcoriaceous, glabrous, pectinato-pinnatifid, narrowed (often suddenly) below into a wavy or crenate wing to the stipe, the veins indistinct, usually forked, the sori superficial or slightly impressed. The type-species is *P. grammitidis* R. Br. from Australia and New Zealand, and I only know one Malayan species belonging to the group.

P. Curtisii Baker.—*P. decrescens* Christ, Copel. Phil. Journ. Sci. 1 Suppl. II pl. 17 (reduced).—Tenompok to Lumu Lumu (H. 25432, Cl. 27965) Kamborangah (Cl. 28966).

New to Borneo; known previously from Sumatra (Padang, Curtis; G. Sago, Matthew), Celebes (Kjellberg 3534), Philippines and New Guinea (Arfak Mts., Gibbs 5654). The Kinabalu specimen is quite typical, medium-sized (leaves 25 by 5 cm.), abruptly narrowed into a wavy wing to the stipe. The species grows much larger; Matthew collected specimens with leaves 40–50 by 13 cm.

THEMELIUM MOORE.

(Group of *P. millefolium* Bl.).

This group of several Malayan-Polynesian species is so different from all other groups of free-veined Polypodia that it is natural to segregate it as a subgenus or even as a genus.

P. taxodioides Baker 1879: 42.—*P. pulcherrimum* Copel., Elmer Leaflets 3: 841. 1910.—s.l. (Burbidge, type), Marei Parei Spur (Cl. 11040).—Sarawak: Mt. Murud (Mjöberg).—Mindanao (Elmer 11355, Herb. Copel.). Celebes (Kjellberg 1447).—New Guinea (Keysser).

P. millefolium Bl.—Marei Parei spur (Cl. 11058).

P. halconense Copel. Phil. Journ. Sci. 2C: 138, t. 2. 1907.—Falls above Lumu (Cl. 30447).

THYLACOPTERIS (Kunze, J. Smith).

P. papillosum Bl.—Kiau to Lobang (Tp. 1588), Dallas, on rock by stream (H. 25143, Cl. 26488, 26892, 27290), Tenompok (Cl. 29572).

This (the only species of its group?) resembles *P. vulgare* more nearly than does any other Malayan "Eupolypodium", and in my opinion both species are much more closely related to *Goniophlebium* than to any group of free-veined species. I find no character, the free veins excepted, by which it differs from several Malayan species of *Goniophlebium* § *Schellolepis* with immersed sori. It stands to such species exactly as *P. vulgare* stands to the Asiatic species of *Goniophlebium* with superficial sori.*

GROUP OF *P. COLORATUM*.

A small group of three described Bornean species of doubtful systematic position. Copeland placed them in *Goniophlebium*, but I am by no means convinced that this is right. The venation is much less regular; the veins form irregular areoles which are not always closed. I hope to return to these species later, but will here remark that I find more common features (scales, colour, texture and venation) between them and the group of *P. taeniatum*.

P. brachypodium Copel. 1917: 62.—Gurulau spur (Tp. 1620, 1823), Lobang (Cl. 10354), Kiau (Cl. 10225), Tenompok (Cl. 28344).

This species is hardly different from *P. coloratum* Copel..

GONIOPHLEBIUM § *Schellolepis* J. SMITH.

P. integriore Copel. Phil. Journ. Sci. 2C: 139. 1907.—Tenompok (Cl., s.n.).

This agrees with the description except that the pinnæ are not linear but narrowly elliptico-lanceolate, 10 by 1.5 cm. I have the same from Sarawak (Mt. Penrissen, Mjöberg).

var. *rajaense* C. Chr.—*P. rajaense* C. Chr. Mitt. Inst. allg. Bot. Hamburg 7: 159. 1928.—Tenompok, climbing on trees and creeping on ground in forest (H. 25393, Cl. 29484, 26855).

Differs from the type in the pinnæ being twice as broad, and in having five pairs of pinnæ.

P. subauriculatum Bl.—Near Kiau, in secondary forest by stream (Cl. 10006, H. 25594), near Lobang, open place in forest (H. 25547), Dallas-Tenompok ridge, summit (Cl. 27431), Menetendok gorge (Cl. 29625).

P. pallens Bl., v.A.v.R. Handb. 620.—Tenompok, on tree (H. 25416), top of Menetendok Gorge, clambering over ground (Cl. 29627).

* See my paper: On the systematic position of *Polypodium vulgare*. Dansk. Bot. Arkiv 5 no. 22. 1928.

New to Borneo. This resembles a small frond of *P. subauriculatum*, to which *P. pallens* was referred as a variety in my Index. It differs by the whole leaf being densely villous with short and crisped, articulate, whitish hairs. It is possible that *P. pallens* represents a young stage of *P. subauriculatum*; young plants of *P. verrucosum* are similarly though less densely hairy, and are often prematurely fertile. The present specimens have about 20 pairs of pinnæ, which are 8 cm. long, 8 mm. wide, sessile and articulated to the rachis, unevenly crenate, the sori deeply immersed with papillæ on the upper side. By the last character it differs from *P. molliculum* Copel., which may be a form of the same species.

***P. verrucosum* Wall.**—Dallas-Tenompok ridge (Cl. 27350).

This agrees exactly with typical specimens from the Malay Peninsula. The pinnæ are long-stalked.

SERIES II SPECIES WITH MORE OR LESS IRREGULARLY NETTED VEINS (The subgenera *Pleopeltis*, *Selliguea* and *Myrmecophila* pt. of *Index Filicum*).

Copeland unites most of the many groups falling under this series in a single genus, *Microsorium*, which however includes such widely different species that his treatment does not seem to me an improvement. In my opinion, his genus can be divided into several natural groups (subgenera or genera), but, because of the relatively few species dealt with below, this paper is not the right place to give my reasons for this opinion, which must be supported by reference to a considerable number of species; I confine myself therefore to placing in parenthesis the name of the group to which each species belongs.

P. (Crypsinus) kamboranganum C. Chr. n. sp.—Species dimorpha, *P. costulato* Baker et *P. Wrayi* Baker affinis, a priore differt foliis sterilibus ellipticis, basi longe decurrentibus, soris rotundis, a posteriore paleis rhizomatis integerrimis, venis lateralibus distinctis.

KINABALU: Kamborangah, epiphyte in ridge forest (H. 25543, type in Herb. C. Chr.).

Rhizome creeping, densely clothed with reddish-brown, lanceolate, long-acuminate and quite entire scales. Sterile leaves 12–13 cm. long including the stipe (3 cm.), 2 cm. wide in the middle, subacute at the apex and long cuneately decurrent at the base, glabrous, chartaceous, the margins with shallow notches between each two distinct main veins. Fertile leaves up to 20 cm. long including the stipe (5 cm.), 5–8 mm. wide, linear and decurrent. Sori superficial, round, uniseriate, not confluent but reaching both costa and margin when mature.

I cannot identify this form with any of the many Malayan species of this group. Its nearest ally is the Sumatran *P. costulatum* Baker (not *Acrostichum costulatum* Cesati) which differs in its ovate, not decurrent sterile leaves and oblong or linear, often confluent sori. In general habit our species more nearly resembles a broad form of the Peninsular *P. Wrayi*,* which has finely ciliate scales and invisible main veins.

P. (?) *tæniophyllum* Copel. Phil. Journ. Sci. 7C: 65. 1912.—Dallas (Cl., s.n., sterile).

P. (Crypsinus?) *accedens* Bl.—s.l. (Tp. 1812), Tenompok (Cl. 26704, 26851, 28199), Kabayau (H., s.n.).

P. (Crypsinus?) *stenopteris* Bak. 1879: 43.—*P. soridens* Bak. 1894. 253.—s.l. (Burbidge, type; Haviland 1493, Haslam), above Kamborangah (Gibbs 4225), Pakka to Lobang (Tp. 1734, Cl. 10716), Lumu Lumu to Kamborangah (H. 25453, Cl. 27063, 27961), Silau basin (Cl. 29277).

P. (Crypsinus?) *stenophyllum* Bl.—s.l. (Haviland 1489).

The systematic position of the last four species is still uncertain to me.

P. (Pleuridium) *rupestre* Bl.—Tenompok to Lumu Lumu (H. 25441, Cl. 27423), Silau basin at 7000 ft. Cl. 29030, 29705).

P. (Pleuridium) *sarawakense* Baker—*P. peltatum* v.A.v.R. Handb. 632.—*Pleopeltis peltata* Scort., Ridley Journ. Mal. Br. R. Asiatic Soc. 4: 91.—Kiau (Tp. 1574, Cl. 10240), near Dallas, on fallen tree by stream (H. 25148, Cl. 27349), Dallas-Tenompok trail (Cl. 26942, 29582).

Common in Sarawak, and now also recorded for Sumatra (Hancock 79) and the Peninsula.

P. (Pleuridium) *zippelii* Bl.—Near Menetendok, on rocks by stream (H. 25297, 25589), Tenompok, epiphytic (Cl. 29231, 26929).

P. (Pleuridium) *albidopaleatum* Copel. 1917: 63.—Pakka to Lobang (Tp. 1748), Marei Parei ridge (Cl. 11060), Lumu Lumu to Kamborangah, on mossy tree trunk (H. 25452, Cl. 28387).

P. triquetrum Gepp p. 204 (Gibbs 4155) is probably this species.

* *P. Wrayi* has hitherto not been found in Borneo, though it is included in Copeland's Keys (p. 401); the species from Sarawak formerly referred to it has recently been described as a new species, *P. Clemensiae* Copel. Brittonia 1: 76, pl. 2. 1931. This chiefly differs from *P. Wrayi* by its less dimorphous fronds and biseriate sori; it is however not a new species but identical with *P. subsparsum* Baker from Sumatra (Beccari, Herb. Inst. bot. Firenze no. 12593), and *P. Beccarii* v.A.v.R. Handb. 633 is a synonym (based on the same collection?).

P. (Pleuridium) platyphyllum Sw.—Tenompok, epiphyte (Cl. 29545).

P. (Microsorium) heterocarpum Bl.—*P. Zollingerianum* Kunze, C. Chr. Index.—*Nephrodium pteropodium* Bak., *Aspidium pteropodium* Diels, C. Chr. Index, *Tectaria pteropoda* Copel. Keys 368.—*Polypodium Scortechinii* Baker.—Tenompok, on rocks and trees (H. 25720), near Kabayau, on rocks and trees by stream (H. 25628), Dallas, east ravine (Cl. 27305), Dallas-Tenompok ridge (Cl. 26800).

H. 25628 is a very large form with the lamina 10 cm. wide, ovate, suddenly narrowed into a long wing.

P. (Leptoselliguea) fluviatile Lauterb., Engler's Bot. Jahrb. 44: 507. 1907.—s.l. (Tp. 1491). Bettotan, near Sandakan (Boden Kloss 18733).

Extremely dimorphous, the long fertile leaves sometimes not more than 2–3 mm. wide; the sterile ones are hardly different from those of *P. selliguea* Mett.

P. (Leptoselliguea) interruptum C. Chr.—Lobang (Cl. 10357), near Tenompok, on rocks by stream (H. 25300, Cl. 29312), falls above Lumu (Cl. 29968).

The Kinabalu form is not quite identical with the type from Sarawak (Hose 238, *Gymnogramme acuminata* Bak.), but it cannot be separated specifically. The leaves are longer decurrent and the sori larger and shorter, mostly round. Both forms may be varieties of *P. macrophyllum* (Bl.) Reinw., which seems to be a very variable species and to which, when taken in a wide sense, most of the thin-leaved Selliguesas might very naturally be referred. A very peculiar form has been collected by the Clemens expedition at Menetendok (Cl. 29624); some fertile leaves are broad, with linear or interrupted sori, while some are only 1.5 cm. wide (the lamina over 30 cm. long) with a single row of large irregular roundish sori on either side of the midrib.

P. (Leptoselliguea) polysorum Brause, Engler's Jahrb. 56: 203. 1920.—Tenompok (Cl. 26184, 28642). Type from Papua; new to Borneo.

This species, allied to *P. macrophyllum*, is marked by the subsessile, long-decurrent, oblanceolate, isomorphous fronds and the very broad sori which when mature are almost contiguous and run at an angle of 40–45° from the midrib to the margin, sometimes protruding beyond the latter; sori are borne throughout the length of the fertile fronds, from the tip down to the wing-like lower portion of the blade. The climbing rhizome is densely covered with fuscous brown, very thin (not clathrate as described by Brause), broad and long-acuminate, obscurely dentate scales.

Under the name *Leptoselliguea* sect. nov. I unite a number of Malayan species which were previously referred to *Selliguea*. The latter name I use, however, only for the coriaceous species (*P. Féei*, *P. Mettenianum*, etc.), which are derivatives of *Pleuridium*, while *Leptoselliguea* is a group of species of herbaceous texture and dark green colour which agree with *P. heterocarpum* and related species in almost all characters, differing by the uniseriate, often confluent and linear (selligueoid) but sometimes round (polypodioid), sori; both kinds of sori may be found in the same species. The pinnatifid species of *Selliguea* look rather different from both groups, but some South-Chinese species seem to connect them with the simple-leaved species of *Leptoselliguea*. The type-species of this section is *P. macrophyllum* (Bl.) Reinw.

P. (Phymatodes) **insigne** Bl.—Below Dallas, on wet rocks by waterfall (H. 25274, Cl. 27291). New to Borneo.

P. (Phymatodes) **commutatum** Bl.—Kiau (Cl. 10008), near Menetendok, on rocks by river (H. 25572, Cl. 29582).

P. (Phymatopsis) **ithycarpum** Copel. 1917: 64.—Kiau (Tp. 1578), Lobang (Tp. 1778), near Menetendok, on trees by river, abundant (H. 25568), Dallas, east ravine (Cl. 27294, 27025), Tenompok (Cl. 28387).

A very large fern, probably over 1 m. high. Rhizome 1 cm. thick, wide-creeping, the scales broadly ovate or roundish, thin, dark brown; stipe 40 cm. long, 1 cm. thick; pinnæ several pairs, 30–35 cm. long, 3.5–4.5 cm. wide, connected by a wing 1 cm. broad. It is with doubt that I maintain this species, as I do not see clearly how it may be distinguished from *P. longissimum* Bl.

P. (Phymatopsis) **tæniatum** Sw.—*P. palmatum* auctt., C. Chr. Index.

This species comprises in my opinion an intricate complex of forms, several of which have been treated as species by some writers; a comparison of a great number of specimens has shown it impossible to regard these forms as good species, as apparently all possible intermediates between the extreme forms occur; Sumatra and Borneo are especially rich in such forms. I cannot here give a complete review of all the many forms, but mention briefly a few of the Bornean ones.

forma typica.—*P. angustatum* Bl. Fl. Jav. pl. 62.—Fully pinnate with nearly all pinnæ distinctly narrowed toward their base, the leaves somewhat dimorphous, the fertile ones with narrower pinnæ, often under 1 cm. wide, the sterile pinnæ lanceolate, 1.5–2 cm. wide. The type specimen in Herb. Thunberg (Upsala) matches Blume's excellent plate quoted above. *Pleopeltis subtaeniata* v.A.v.R. Handb. Suppl. 402 is very nearly the

same. Kinabalu specimens are: Kamborangah (H. 25721), falls above Lumu, on rocks (Cl. 29971), Tenompok (Cl. 28245), above Pakka (Cl. 27757).

var. palmata (Bl.) C. Chr.—*P. palmatum* Bl. Fl. Jav. pl. 64.—*P. laciniatum* Baker 1894: 253, *P. macrochasmum* Copel. Keys 404.—*P. ebenipes* Baker 1879: 43, Copel. Keys 404.—*P. Moseleyi* Baker.—*P. quinquefidum* Baker.—*Pleopeltis taenitidis* v.A.v.R. Handb. Suppl. 402.—Fertile and sterile leaves similar, pinnate below only or deeply pinnatifid throughout, the pinnæ sessile with a much widened base or confluent by a wing to the rachis, sometimes 2.5 cm. wide. Kinabalu specimens: s.l. (Haviland 1490, Haslam), Marei Parei ridge (Cl. 11066).

P. crenulatum Mett. (*Pleopeltis taenifrons* v.A.v.R. Handb. Suppl. 402, 527) is scarcely different from var. *palmata*; it is a form with the fronds simple or at best with 1–3 pinnæ.

var. borneense (Christ) C. Chr. *P. Griffithianum* v. *borneense* Chr. Ann. Jard. Bot. Buitenz. 20: 122, Copel. Keys 402.—Fronds simple, the lamina up to 25 cm. long, 5 cm. wide, the fertile ones a little narrower and longest; or fronds pinnate with 1 or 2 pairs of lateral pinnæ, in which case they are distinctly dimorphous, the fertile intermediate between *f. typica* and var. *palmata*, fully pinnate with the pinnæ adnate to the rachis but not widened, about 1.5 cm. wide, the sterile having pinnæ 3–5 cm. wide. This form has, of course, nothing to do with the Himalayan-Chinese *P. Griffithianum* Hk. No specimens of this have been found on Kinabalu, but other Bornean specimens are: Dutch Borneo (Hallier 684, 3286), Sarawak (Mt. Dulit and Mt. Penrissen, Mjöberg; Bongo Range, Brooks & Hewitt 9).

I may add that in my opinion the characters by which v.A.v.R. distinguished his five species (the rhizome cretaceous or not, the scales entire or obscurely dentate, and the venation) do not hold good. I have referred to all the above varieties specimens varying as to these characters.

P. (Phymatopsis) **pakkænse** C. Chr. n. sp.—Rhizomate ad arbores repente, non cretaceo, paleis peltatis, imbricatis, rufidulis, e basi ovata longe acuminatis, integris dense oblecto. Stipite rigido, nitente, ad 25 cm. longo. Lamina chartacea, glaberrima, late et breviter ovata, vix 25 cm. longa, ca 30 cm. lata, basi in stipitem breve decurrente, ad alam 2–4 mm. latam profunde pinnatisecta. Segmentis præter terminalem cum supremis lateralibus confluentem 5–6, late lanceolatis, 15–17 cm. longis, medio 4 cm. latis, sinibus rotundatis separatis,

acuminatis, marginibus incrassatis, leviter serrulatis; venis secundariis subtus prominentibus, usque ad marginem extensis, 3–5 mm. inter se remotis, minoribus subscalpturatis, areolas inter secundarias 3–seriatis, liberas includentes formantibus. Soris utrinque uniseriatis, a costa 3–4 mm. remotis, superficialibus, globosis, 4 mm. diametro, paraphysibus nullis.

KINABALU: Pakka, on mossy tree near stream (H. 25515, type in Herb. C. Chr.), on rocks above Kamborangah (Cl. 27962), Silau basin at 7000 ft. (Cl. 28857).

Described from a single fertile leaf, which shows several of the characters of *P. taeniatum* but is quite different in several respects: the more rigid texture and prominent veins, the segments really serrulate, but very shallowly, not barely obscurely crenate with small notches as in all forms of *P. taeniatum*. Some much smaller leaves, with segments 8 cm. long by 1 cm. wide (fertile), were also taken by Holttum in the same collection; the description therefore applies to leaves of a well-grown plant.

P. (Phymatopsis) incurvatum Bl.—Kamborangah to Pakka, common (Gibbs 3110), Gurulau spur (Tp. 1622, 1743), Tenompok, on ground, edge of forest (H. 25418), Dallas-Tenompok ridge (Cl. 27564), Lumu Lumu to Kamborangah, among rocks (Cl. 27933).

P. (Phymatopsis) albidosquamatum Bl.—Tenompok, on tall tree (H. 25293, Cl. 27904), Dallas-Tenompok ridge (Cl. 28153).

P. (Myrmecophila) sinuosum Wall.—Kota Belud to Kabayau (Cl. 9791).

P. (Drynariopsis) heracleum Kunze.—Lobang to Kiau (Tp. 1805), Menetendok, on rocks by river (H. 25593, Cl. 29668).

PYCNOLOMA C. CHR. Dansk Bot. Arkiv 6, no. 3 p. 75. 1929.

P. murudense C. Chr. l.c. 78, pl. 8.—*Polypodium costulatum* Baker 1894: 254, Copel. Keys 402.—Dahombang river (Haviland 1474), Tenompok (Cl. 28983). Collections from Sarawak are: Mt. Murud (Mjöberg), Mt. Dulit (Hose 310).

LOXOGRAMME PRESL.

L. parallela Copel.—Pakka (Tp. 1717, H. 25504), trail to Kamborangah, on tree (Cl. 28986).

L. ensifrons v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XI: 16, pl. 4. 1913.—Kiau (Cl. 10239), Dallas-Tenompok, a common epiphyte (H. 25291), Tenompok (Cl. 26933, 29229), Dallas, east ravine (Cl. 27307).

In his Keys (p. 408) Copeland quotes *L. ensifrons* as a synonym of *L. iridifolia* (Chr.) Copel. (*Polypodium*

iridifolium Diels, C. Chr. Index), but in my opinion he has misunderstood the synonymy of these species. The plant from Celebes described and illustrated by Christ is the same, or very nearly the same, as *L. antrophyoides* (Bak.) C. Chr. Mitt. Inst. allg. Bot. Hamburg 7: 163. 1928 (*Leptochilus antrophyoides* C. Chr. Index) from Mt. Matang, Sarawak (Hose 162!). I distinguish the two allied species thus:—

L. antrophyoides. Fully dimorphous. Sterile leaves oblanceolate, acute, about 2 cm. wide above the middle, narrowing gradually toward the base, at best 1 cm. wide at the very base; fertile leaves narrowly linear, 3–6 mm. wide from base to apex, much longer than the sterile.

L. dimorpha Copel. is perhaps a form of this with leaves still narrower (2 mm. wide).

L. ensifrons. Subdimorphous. Sterile leaves very like those of the former species, suboblanceolate, 3–5 cm. wide above the middle, 2–3 cm. wide at the very base, the midrib flat and very thick beneath (4–5 mm. wide near base), prominent and angular above. Fertile fronds considerably longer, like the sterile ones in the lower half but usually prolonged into a long attenuated fertile apex, which is about 1.5 cm. wide near the basal sori. The specimens from Kinabalu agree excellently with the type from Labang (Amdjah 267!).

L. involuta Pr. var. *gigas* Copel. Phil. Journ. Sci. 3C: 35. 1908.—Tenompok (H. 25356 bis).

This specimen was placed in the same collection as *L. nidiformis*; in shape and appearance in the field the two are closely similar, and in collecting they were not distinguished. The specimen agrees with Copeland's brief description. The costa is prominent beneath, and the fronds up to 75 cm. long. In texture the frond is more coriaceous than *L. nidiformis* (see below), the veins not quite so distinct, and the areolæ considerably smaller. (R.E.H.).

A specimen from Sarawak (Nat. Coll. Bur. Sci. 1553), named by Copeland *L. involuta* var. *gigas*, is to me a form of *L. avenia* Pr., and different from the Philippine variety represented by Copeland's Pterid. Philip. exsic. no. 87. (C. Chr.).

L. avenia (Bl.) Pr.—*Gymnogramme* Baker 1879: 43.—*Loxogramme Blumeana* Pr. Copel. Keys 408.—Koung (Burbidge), Kiau to Lobang (Tp. 1609).

L. nidiformis C. Chr. n. sp.—Species maxima foliis isomorphis, oblanceolatis, 60 cm. vel ultra longis, ad 12 cm. supra medium latis, sessilibus, versus basin gradatim angustatis, apice breve acutis, tenuiter papyraceis.

costa superne prominente, angulata, inferne complanata, parte inferiore 7 mm. lata; venis sat distinctis, areolis venulas liberas sæpius includentibus. Soris in parte tertia superiori laminæ, angustis, sub angulo 45° oblique e costa currentibus, ca 1 cm. inter se remotis, nec costam nec marginem attingentibus.

KINABALU: Tenompok, epiphyte, frequent (H. 25356, type in Herb. C. Chr.; Cl. 26949), Dallas, on tree by stream (Cl. 27300, 26489), Dallas-Tenompok ridge (Cl. 27037).

This is the largest form of the genus known to me; in size and shape it resembles smaller leaves of *Asplenium nidus*, whence the name. It is not *L. involuta* var. *gigas* Copel., the costa of which is prominent beneath and flat above, but it is related to *L. avenia* Pr., which is much smaller with closer sori.

HYMENOLEPIS KAULFUSS.

H. revoluta Bl.—Tenompok (Cl. 27794).

H. revoluta Bl. var. *planiuscula* (Mett.) Hieron., C. Chr. Dansk Bot. Arkiv 6 no. 3: 58. 1929.—Kiau to Lobang (Cl. 10224, 10396), Dallas-Tenompok (H. 25292, Cl. 26975, 28191), Dallas (Cl. 27503), Kundasan, on tree at 30 m. above ground (Cl. 29106).

H. squamata Hieron. var. *borneensis* C. Chr. l.c. 60.—Pakka to Low's Peak (Cl. 10664, Tp. 1675, 1703), on ground in a thicket of bushes at 11000 ft. (H. 25487, Cl. 27048), above Lumu (Cl. 27955).

CYCLOPHORUS DESVAUX.

C. adnascens (Sw.) Desv., Gepp p. 204.—Gurulau spur (Gibbs 3995, not seen), Dallas (Cl. 29229).

C. varius (Klf.) Gaud.—Koung, on rocky bank among trees (H. 25123), Menetendok, on tree (Cl. 29628), Dallas (Cl. 29299; 27293?, sterile), Tenompok (Cl. 28685).

C. Christii (Gies.) C. Chr.—Dallas (H., s.n., sterile).—Near Sandakan (Boden Kloss 19052).

C. flocciger (Bl.) Pr.—Tenompok (H. 25358), Dallas-Tenompok trail (Cl. 27327).

Rhizome stout, the scales subulate from a nearly black base, stipes short and rather thick, the leaf with much recurved margins, tomentum very loose and woolly, the midrib beneath thick and pale, areolæ fairly regular with about three sori in each; fronds uniform. Exactly similar specimens have been collected in the Malay Peninsula on the Main Range at about 4000 ft. altitude (*e.g.* Henderson 21697).

C. borneensis Copel. 1917: 64.—Kiau (Tp. 1503), Tenompok (Cl. 27479, 26984).

Differs from *C. flocciger* in the following points: rhizome slender, the scales shorter, lanceolate, stipes longer and more slender, leaf drying nearly flat, the margins hardly recurved, the tomentum (of two kinds of hairs as in *C. flocciger*) closely pressed, the midrib beneath slender, sometimes blackish, areolæ rather irregular, narrow, each containing numerous close sori; fronds usually rather dimorphous, sterile to about 12 by 2 cm., fertile 15 by 1 cm. Cl. 26984 has some fronds repeatedly dichotomously branched at the apex.

DRYMOGLOSSUM PRESL.

D. piloselloides (L.) Pr., C. Chr. Dansk. Bot. Arkiv 6 no. 3: 86. 1929.—Dallas, on forest trees (Cl. 27296).

DIPTERIS REINWARDT.

D. conjugata Reinw.—Below Pakka (H., s.n.). A much dwarfed form, growing in a very exposed place on the ridge.

CHEIROPLEURIA PRESL.

C. bicuspis (Bl.) Pr.—s.l. (Burbidge), Gurulau spur (Gibbs 3998), Lumu Lumu to Kamborangah (Gibbs 4159, H. 25451), Falls above Lumu (Cl. 29934), Dallas-Tenompok ridge (Cl. 28339).

Very variable in the size, shape, and texture of the sterile leaves.

PLATYCERIUM DESVAUX.

P. coronarium (König) Desv.—Dallas (Cl. 26495).

MERINTHOSORUS COPELAND

Phil. Journ. Sci. 6C: 92. 1911.

M. drynarioides (Hook.) Copel l.c., *Dryostachyum* Index.—Kiau, on tree (H. 25624), Tenompok (Cl. 29011).

PHOTINOPTERIS PRESL.

P. speciosa Pr.—Koung, banks of the Tampussuk river (Gibbs 4338, t. Gepp, not seen; Cl. 26005). On rocks by the river at Koung, and also higher up, below Dallas.

LECANOPTERIS REINWARDT.

L. carnosa (Reinw.) Bl.—Tenompok (Cl. 27793, 29469).

AGLAOMORPHA SCHOTT.

A. splendens (J. Sm.) Copel. Phil. Journ. Sci. 6C: 141. 1911.—Tenompok (Cl. 29037, 29038).

• DRYNARIA (Bory) J. SMITH.

D. sparsisora (Desv.) Moore.—Tenompok (Cl. 28684).

ANTROPHYUM.

A. parvulum Bl.—Kota Belud to Kabayau (Tp. 1495), Tenompok (Cl., s.n.).

The Tenompok specimen agrees with *A. immersum* var. *spathulinum* Mett. Ann. Mus. Lugd. Bat. 4: 171, pl. 7 f. 4–6. 1869. This is probably a form of *A. parvulum*. Most Malayan ferns referred to *A. immersum* seem to be different from the genuine *A. immersum* from the Mascarenes, and should rather be referred to *A. parvulum*.

A. Lessonii Bory, Dup. Voy. Bot. 225, pl. 22 f. 2. 1829.—Dallas, ravine, on rocks and trunks (Cl. 27402).

The specimen exactly matches Bory's original figure. This form has been united with *A. plantagineum* by almost all writers, but it is no doubt different from the type of the latter species (Guam, Herb. Cavanilles !). *A. Lessonii* is distinct in its long-stalked, ovate or broadly ligulate fronds, which approach small forms of *A. latifolium* Bl. *A. plantagineum* with its lanceolate, short-stalked fronds, was excellently figured by Bory, l.c., fig. 1. *A. simulans* v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XI: 2. 1913 from Sumatra (Matthew !) is probably *A. Lessonii*; Kaudern 47 from Celebes is the same.

A. semicostatum Bl.—Near Dallas, on rock by stream (H. 25150), Kamborangah, on trees near stream (H. 25536), Tenompok (Cl. 29417), Dallas, east ravine (Cl. 27455, 27040).

A. coriaceum Wall.—Dallas, on tree in East ravine (Cl. 27441).

The determination is somewhat doubtful. *A. coriaceum* is the Malayan plant commonly called *A. reticulatum*, but is different from the latter species, which is Polynesian.

A. callifolium Bl.—Below Dallas, on rocks and trees by stream (H. 25362, Cl. 26384, 27137, 27492).

var *magnum* C. Chr. var. nov. Fronds of mature plants very broadly spatulate, to about 45 cm. long and 12–15 cm. wide, the widest part just below the apex; the apex shortly acute, with occasionally short acute lobes on either side of it. Younger plants not clearly distinct from typical *A. callifolium*.

Bettotan, near Sandakan (Boden Kloss 18726). Kina-balu: Dallas (Cl. 27454).

Among a large number of collections of *A. callifolium* from the Malay Peninsula, none have fronds of this peculiar shape; this would indicate that var. *magnum* is not the normal fully adult form of the species, but is probably a

local race. It is possible that the other specimens referred above to *A. callifolium* are younger plants, but there is no definite evidence of this. Plants of *Antrophyum* appear to produce fertile leaves of small size from an early age; this is one reason why they are not easy to discriminate systematically. (R.E.H.).

VITTARIA SMITH.

V. angustifolia Bl.—*V. angustata* v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XVIII: 43. 1918.—Near Tenompok, on mossy tree trunk (H. 25437), Kamborangah (Cl. 27953), Dallas, East ravine (Cl. 27441A).

V. elongata Sw.—Koung to Kabayau (Tp. 1908), Lobang (Cl. 10325), Tenompok (H. 25419, Cl. 29581, 27512).

V. zosterifolia Willd. (type from Mascarenes) appears to be identical with this species.

V. lineata (L.) Sw.?—Kiau (Cl. 10007), s.l. (Haslam).

I do not know what name should be given to this Malayan form; it is hardly conspecific with the American *V. lineata*.

V. ensiformis Sw.?—Dallas (Cl. 27443), Tenompok (Cl. 28185).

MONOGRAMMA SCHKUHR.

M. trichoidea J. Sm.—Tenompok, on tree in forest (H. 25715, Cl. 29574).

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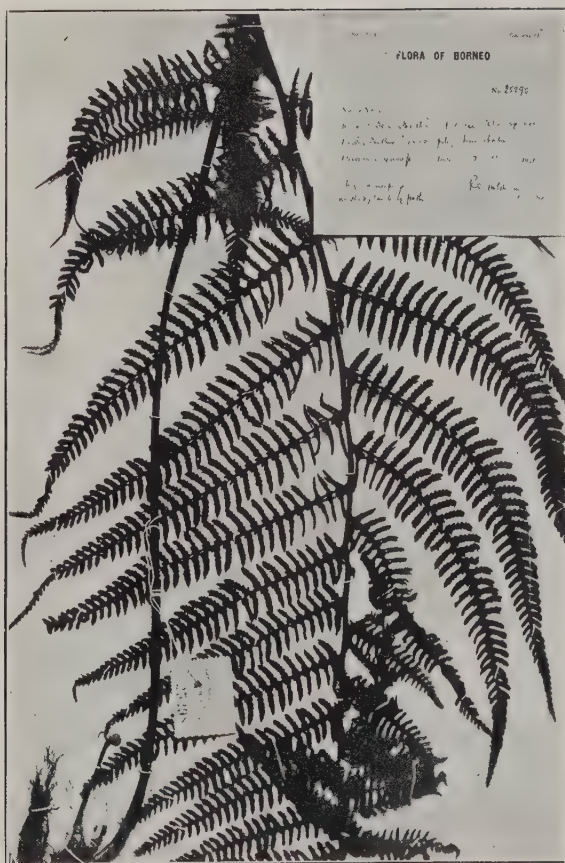
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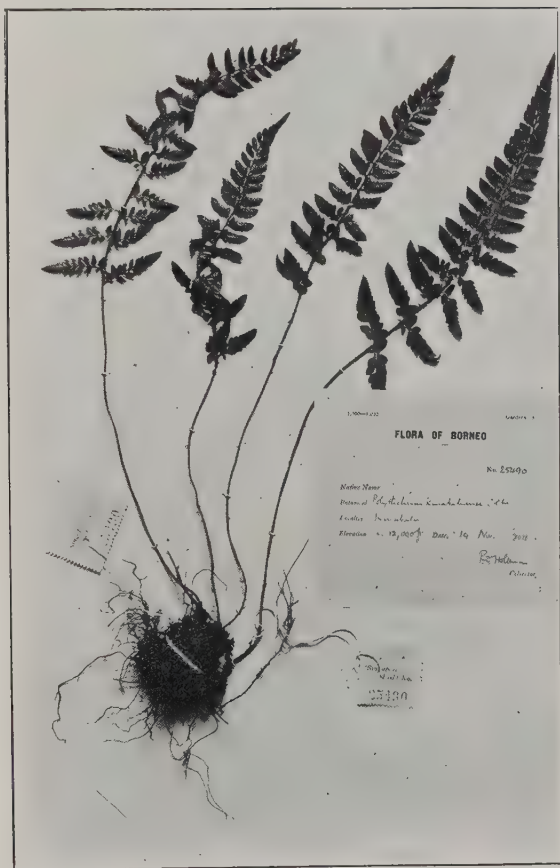
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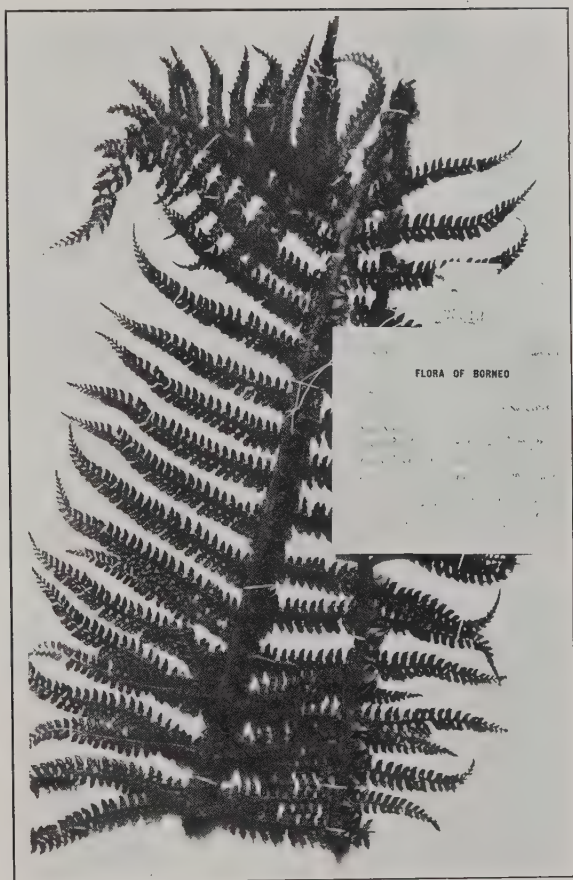
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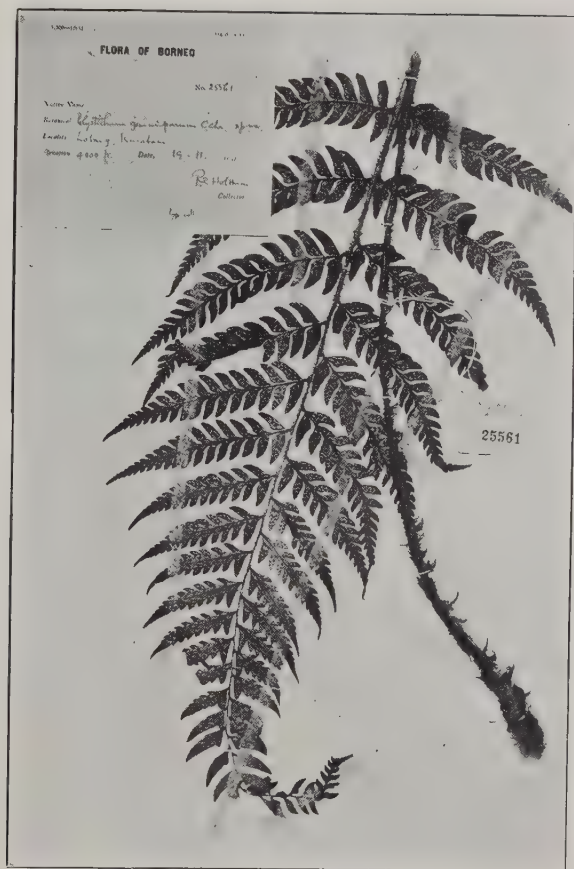
Dennstaedtia rufidula C. Chr. H. 25298, $\times 1/3$.



Polystichum kinabaluense C. Chr. H. 25490, $\times 1/3$.



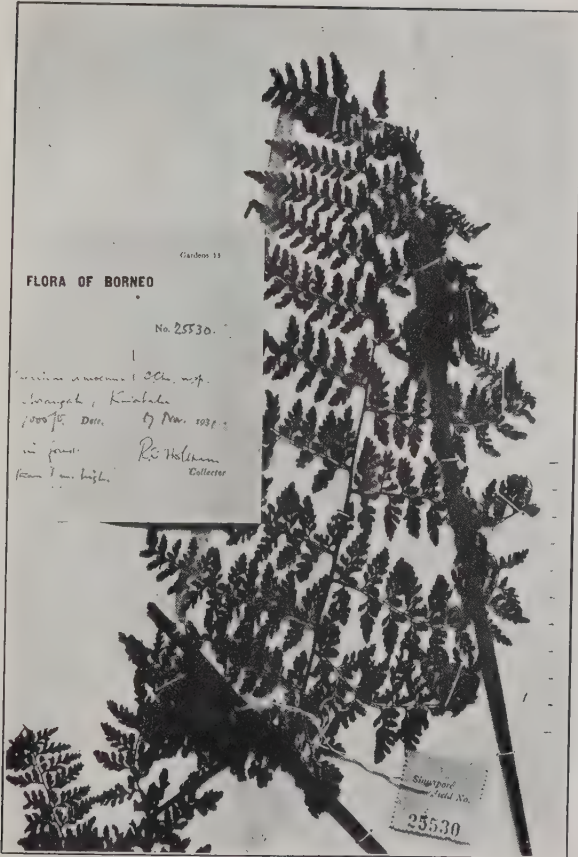
Polystichum Holttumii C. Chr. H.25513, $\times 1/3$.



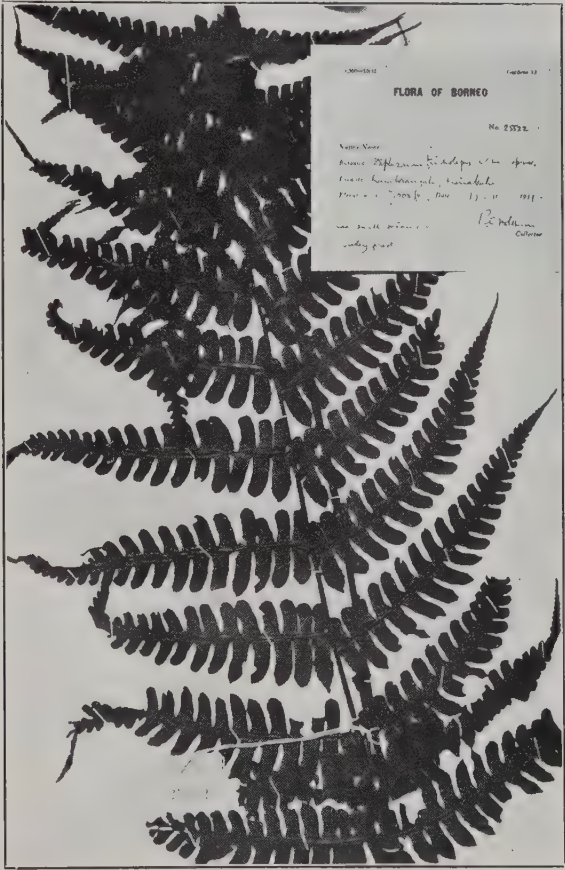
Polystichum gemmiparum C. Chr. H. 25561, $\times 1/3$.



Tectaria Holttumii C. Chr. H. 27313, $\times 1/3$.



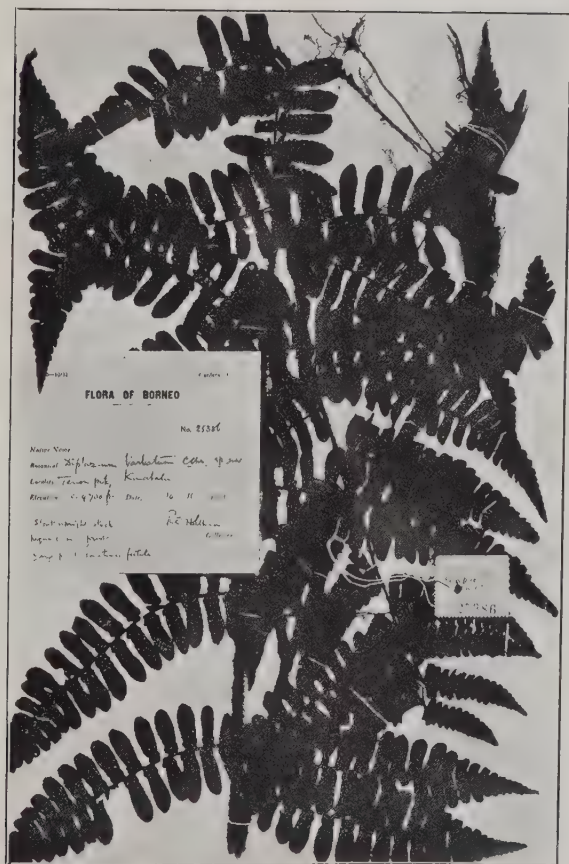
Athyrium amoenum C. Chr. H. 25530, $\times \frac{1}{2}$.



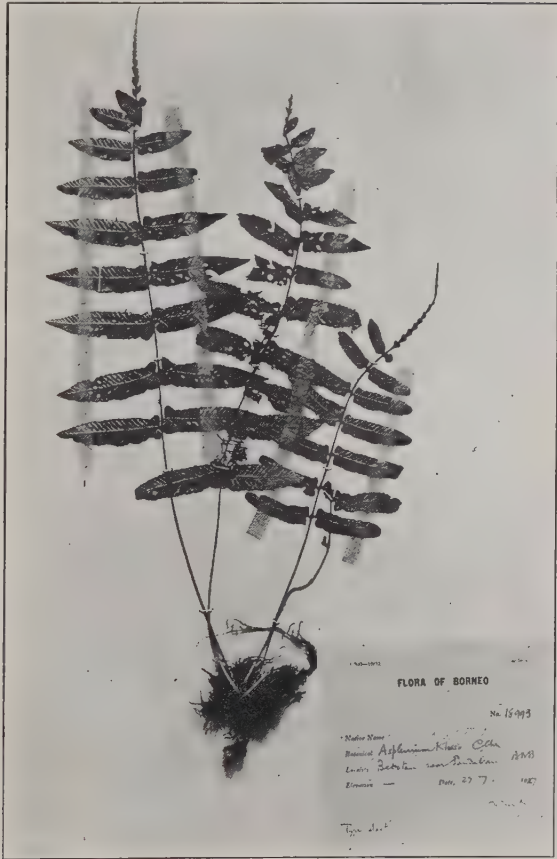
Diplazium tricholepis C. Chr. H. 25522, $\times 1/3$.



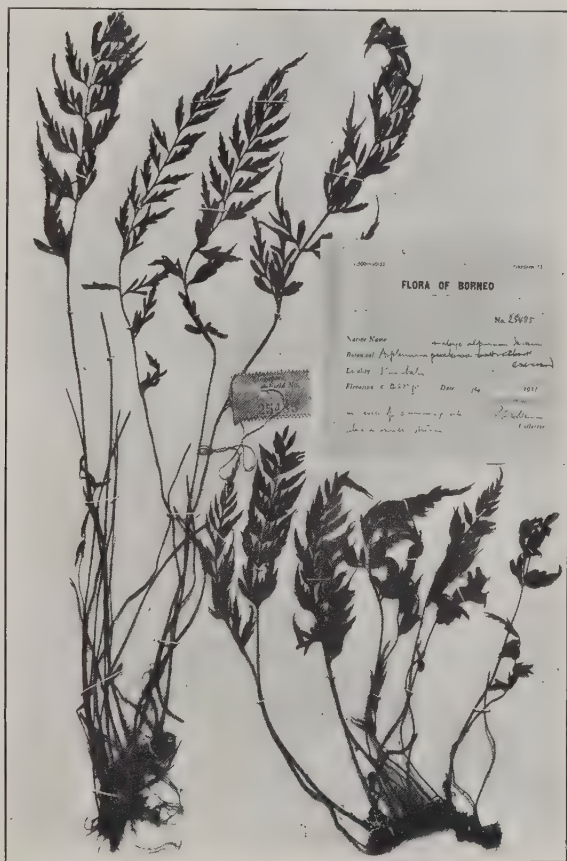
***Diplazium laevipes* C. Chr. H. 25259, $\times 1/3$.**



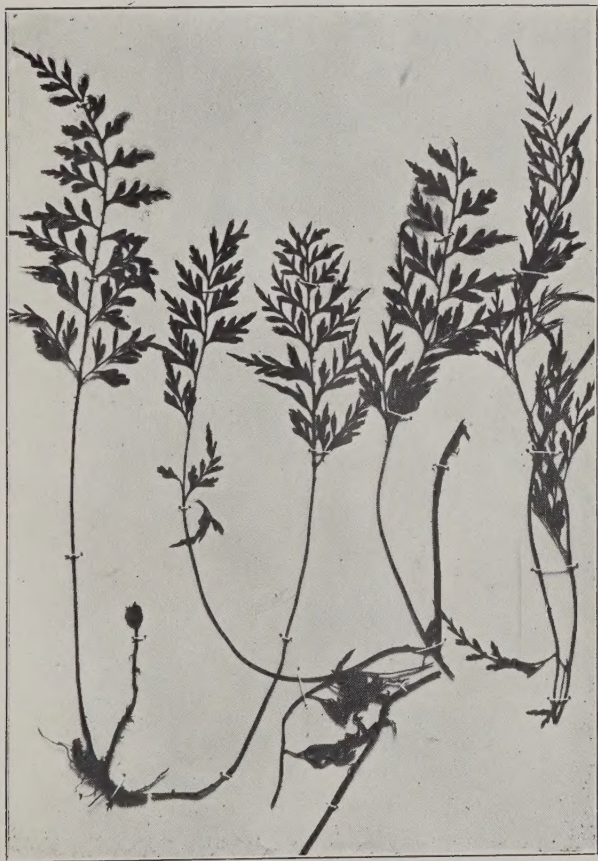
Diplazium barbatum C. Chr. H. 25386, $\times 1/3$.



Asplenium Klossii C. Chr. Kloss 18993, $\times 1/3$.



Asplenium malayo-alpinum Holttum H. 25485, $\times 1/3$.



Asplenium kinabaluense Holttum Cl. 29830, $\times \frac{1}{2}$.

DEPARTMENTAL NOTICES

A list of plants which can be purchased at the Botanic Gardens in Singapore and Penang can be had on application. The same list appears at intervals in the Government Gazette.

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